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Fever Therapy with Diathermy

Various chronic diseases now treated by this method

IT is little more than two years since the first published articles [1, 2, 3] on the use of diathermy in the production of therapeutic fever aroused interest in the possibilities of this new method.

The encouraging clinical results reported by these early workers in the treatment of paresis, and their predictions that diathermy would ultimately prove quite as valuable in the treatment of other chronic diseases, have led to a considerable amount of investigation and research which elicit world wide interest.

Subsequent articles by Feinberg and Osborne [4], and by Schmidt and Weiss [5], reporting favorable clinical results with diathermy used to produce fever in the treatment of allergic disease and multiple sclerosis, respectively, have served to further intensify the interest in this method of fever therapy.

In your consideration of apparatus for this form of therapy, allow us to submit to you reprints of several articles on the subject, in which the authors state the essential requirements of equipment suitable for this work.

The Victor Super-Power Diathermy Apparatus was specially designed for this particular purpose. From the standpoint of energy output, it will give as much current as any patient can tolerate through the chest and abdomen, with the largest size electrodes used thus far in this work. The maximum degree of fever is therefore reached in the shortest possible time.

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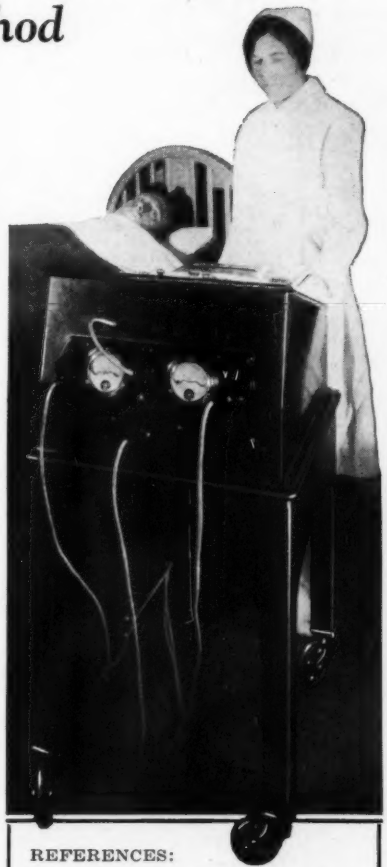

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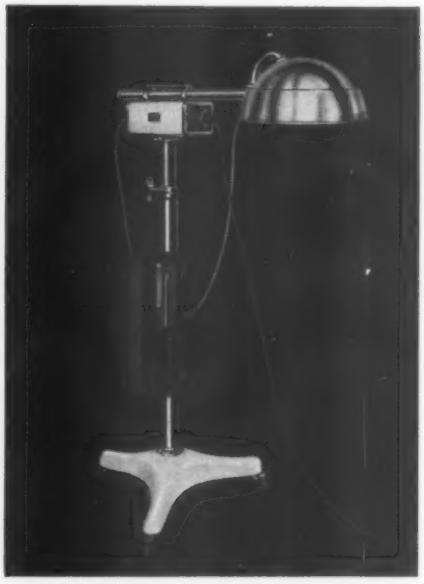

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THE EFFECT OF ULTRAVIOLET ENERGY ON ERYTHROCYTES IN "VITRO"

EDGAR MAYER, M.D. AND MORRIS DWORSKI

NEW YORK

(From the Saranac Laboratory for the Study of Tuberculosis, Saranac Lake, New York)

The study of the effect of light on single cells may finally lead to an understanding of the general nutritional effects of this agent in disease. It is our aim, therefore to report microscopic observations of the cycle of degenerative changes during the hemolysis of non-nucleated and nucleated red blood cells produced by ultraviolet energy.

Hasselbalch[1] produced hemolysis with ultraviolet and showed that the wavelengths below 310 m.μ were the exciting rays. Furthermore, by irradiating the cells in a high vacuum, he demonstrated that oxygen was not necessary for the reaction.

Busck,[2] using a carbon arc as his energy source, proved that the rays capable of producing the hemolysis were filtered out by glass. But he believed that oxygen was essential to the reaction.

Earle,[3] using as a light source, incandescent tungsten filament vacuum or gas-filled globes, with a current consumption of 15 to 200 Watts and operated at 6 to 120 volts, was able to hemolyze red cells in a hanging drop culture in an average time of 100 minutes. The spectrum of the unfiltered light showed a continuous band to 350 m.μ. With various filters he was able also to irradiate the cells with light in each of the three spectral zones of the visual spectrum between 430 m.μ-550 m.μ, 475 m.μ-630 m.μ and 690 m.μ. Furthermore, within the range of intensities employed there was little or no difference in rate at which light of these three regions acted on the red cells. He employed a hanging drop culture slide which contained a volume of air about 50 times the quantity of the enclosed blood. However, when he used flat preparations of whole blood, he was unable to cause any appreciable hemolysis in seven hours irradiation. Many exposed specimens appeared the same as the control cells kept in the dark. He attributed the difference between the hanging drop culture and the flat culture to the presence of oxygen in the former. These findings will be discussed later in this paper.

Procedure

Light Source—The ultraviolet radiations were obtained from a water-cooled quartz mercury-vapor arc, operating at 110 volts, 5 amperes, A. C. (Kromayer lamp). The available ultraviolet region of a Kromayer lamp burner extends to 230 m.μ, Fig. 1. Through the courtesy of Dr. Wm. T. Anderson, Jr., of the Hanovia Chemical Co., graphic pictures (Fig. II), of the ultraviolet transmission of the glass slides used in the control preparations were made. The fused quartz slides have a per centage transmission of 92 per cent at 302 m.μ, the point at which glass slides begin to transmit some energy (2 per cent). Practically no heat is transmitted through the water filter. A thermometer placed 2.5 cm. from the window of the burner rose only 1.75° C. above room temperature after one hour of continuous operation. The ultraviolet was brought to the microscope through a quartz applicator 12 cm. long. The radiation surface, 1.8 cm. square, is placed on the microscopic stage flush with the quartz Abbe condenser. The condenser has a depth of 3.7 cm. and the upper surface area is .7845 sq. cm. The radiation produces a brilliant white light in the microscopic field.

Energy Measurement—The oxalic acid — uranyl sulphate method described by Anderson and Robinson[4] was used. Relative determinations of the amount of ultraviolet reaching the microscopic field were made for the two intensities of the burner. Under the conditions of this test 1 mg. of oxalic acid is decomposed in 30 minutes by the complete ultraviolet band and corresponds to 4.84×10^5 ergs per second. The lamp was run for 25 minutes before energy tests were made, and the same time elapsed before any experimental exposure was made. The lamp burning at first intensity gave a relative average energy output of 4.77×10^5 ergs per second; and at second intensity, 1.03×10^6 ergs per second.

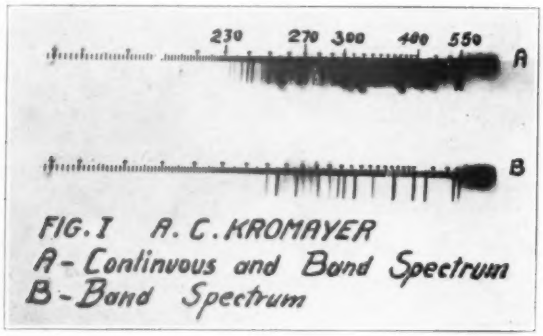

FIG. 1 A. C. KROMAYER
A - Continuous and Band Spectrum
B - Band Spectrum

Experimental Exposures

Human, guinea pig and frog red cells were studied. The human blood was taken from the finger, the guinea pig blood from the ear and heart, and the frog blood from the heart. A small drop of whole blood was placed on a clean cover slip which was immediately turned face down on a quartz slide. The slip was sealed with salvoline to prevent drying. Controls were made in the same manner with glass slides. These are known as flat preparations and are relatively free from oxygen. The slides were observed with oil immersion 1.9 mm. objective and 10x eyepiece, giving a magnification about 1,000. With this magnification there were an average of 50 red cells per field. Irradiation and microscopic examination of the blood was carried on simultaneously. A suitable microscopic field was chosen for study and the time was noted in which the various changes occurred.

Observation on Human and Guinea Pig Red Cells

The observations were made at room temperature (21°-23° C.) and were based on experiments made on human blood, six at first intensity and twelve at second. On guinea pig blood, six experiments were made at each intensity.

The speed of the change depended upon the quantity of ultraviolet energy absorbed. With the first intensity the cycle of changes varied from 12 to 25 minutes with an average of 19.5 minutes for the human cells and from 17 to 25 minutes with an average of 21 minutes for the guinea pig cells. With the second intensity the cycle was completed from 8 to 16 minutes for the human and 9 to 14 minutes for the guinea pig cells. There appeared to be no difference between the reaction of the human and guinea pig cells to the irradiation except that at the first intensity exposure the guinea pig cell was slightly more resistant to the rays. The completion time was taken when practically all of the cells in the field under observation were hemolyzed and were transparent. There are always a few cells which did not completely hemolyze. The resistance of these cells may be due to dust particles on the slide that prevented the absorption of energy.

First Phase—When all movement of the cells had ceased, irradiation was started. The red cells appeared opaque and pea green under the ultraviolet compared to the straw color when viewed by daylight or the usual microscopic tungsten lamp. There was a slight difference in the intensity of the color in the center of the cell but it was not nearly as marked as the pallor seen in the controls. For the first four to five minutes no change was noted. An occasional cell will send out a fine hairlike projection with knobs at the end, but there is no general change of cellular form. If any cells were crenated before irradiation, the crenation was lost and they assumed a spherical form. Soon the effect of the energy became evident. The cells exhibited slight movement and changes in contour. Some showed marked swelling and lost their spherical outline, others clumped and seemed to fuse. Some cells sent out fine protoplasmic processes which appeared in active movement. These small filaments often broke off. Around the periphery of many of the cells there was a ring of refractive bodies. This variation in form was regarded as the beginning of cellular death. In the controls at this time no such changes occurred. A few cells showed some distortion in shape.

Second Phase—The next intracellular man-

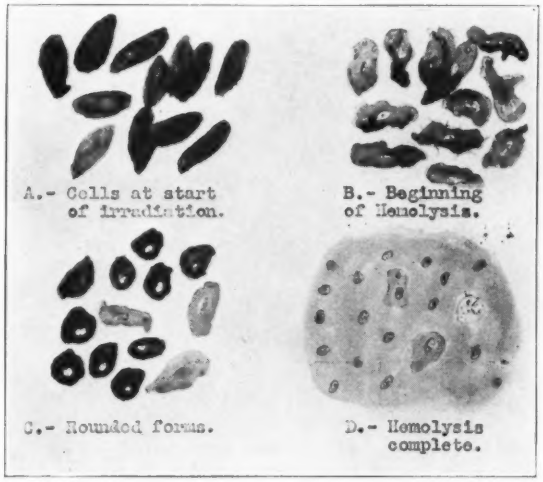

Fig. 2. Transformation of irradiated erythrocytes (Human); average time 19.5 minutes.

ifestion under first intensity at the 8th to the 15th minute was a change in color. The cells were now a lighter green. They became less opaque and here and there single and small clumps of refractile bodies appeared which varied from 0.5 μ to 2 μ in diameter. The majority were the size of platelets. These bodies were free from pigment. The field between the cells which had been perfectly white now appeared faintly yellowish green, suggesting that cell pigments had been liberated. At no time was actual rupture of a cell observed.

Final Phase—The majority of the cells disappeared from vision rather rapidly and there remained only a few colorless and transparent ringlike forms and an occasional unhemolyzed cell. The suspending fluid had now become deep yellowish green in color. There was no evidence of intracellular coagulation, but the cytoplasm only became progressively translucent. Exposure of unicellular organisms and leucocytes is ordinarily characterized by coagulation of intracellular structures. If most of the light was shut off, the red corpuscles appeared not to be entirely disintegrated but in most instances a ring-like membrane persisted. Many had refractile bodies adhering to the outer side wall. Therefore, we have inferred that under the influence of ultraviolet the pigment and other cell contents were extravasated through the wall. Grossly, a clear zone on the cover slip showed where the cells had been hemolyzed.

The ability of ultraviolet energy to restore crenated cells to normal shape was clearly observed with a 25 per cent suspension of washed guinea pig red cells in a 9 per cent NaCl. Practically every cell was crenated when irradiation was started. Using the second intensity the crenation began to disappear at 3 minutes and most of the cells assumed normal shapes. Six observations averaged 8.5 minutes for complete hemolysis. The most rapid hemolysis may be due to the absence of serum.

Control slides were exposed to ultraviolet for 70 minutes. The transmission of energy by these slides is given in Fig. II. Some cells were distorted in shape but no hemolysis occurred; therefore, in the time noted, the ultraviolet responsible for hemolysis was absorbed by the glass.

Observations on Nucleated Cells — Frog Erythrocytes.

The cycle of changes produced in the frog's red cell by ultraviolet irradiation was more complex. In this animal the erythrocyte is oval in shape, nucleated, and varies from 20 μ to 24 μ in diameter. Under ultraviolet illumination it appeared light green and not as opaque as the human cell. The oval nucleus in its center was barely visible with no well defined nuclear wall. After five to six minutes the first effects of the irradiation could be noticed. The outline of the cells became wavy and corrugated, so that distortion occurred. Small refractile knob-like bodies pro-

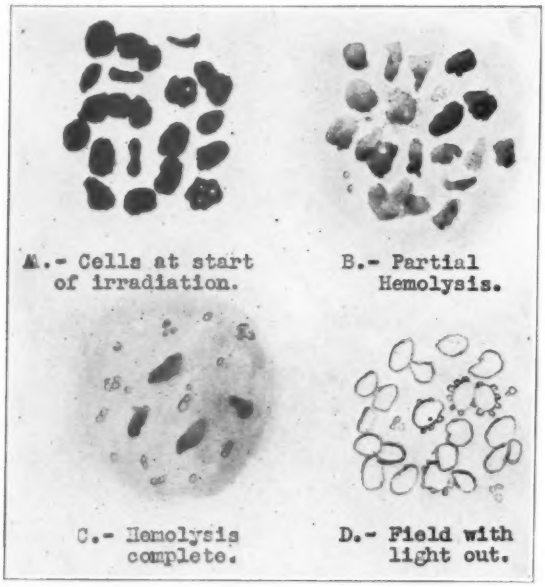

Fig. 3. Transformation changes in irradiated Guinea Pig cells; average time 21 minutes.

truded from the surface of the cell. Vacuoles appeared within the area surrounding the nucleus. Fine protoplasmic filaments were sent out which vibrated vigorously. There was some movement among the cells and when two cells came in contact, they adhered to one another.

The next change was characterized by the disappearance of the attached refractile knob-like structures. The cells, which were previously of various shapes, became spherical and were reduced to about 15 μ to 20 μ in diameter. Their color which at first had been a deep green paled as the exposure continued due to the liberation of pigment. The vacuoles still persisted. The nucleus and nuclear wall became more prominent. The nuclei in many cells migrated to one pole of the cell. This phase persisted for an average of 5 minutes.

Finally when the cell assumed a spherical form disintegration of its contents proceeded rapidly. The bodies of the cells seemed to dissolve before one's eye, leaving the isolated nuclei in a faintly greenish field. The frog cell was completely disintegrated and if it possessed a cell membrane or plasmalemma, this structure was destroyed by the ultraviolet rays, for no ring-like membranes could be discovered after hemolysis was completed. Seven experiments were made with the frog cells, using the second intensity of the lamp. The average time required for complete hemolysis to occur was 21 minutes with limits varying between 16 and 30 minutes. The variation of time in these and other exposures may be due in part to the difficulty of discovering fields with the same number of cells and also to fluctuation in the line voltage. Controls observed for 80 minutes were not hemolyzed, although there were some cells which became distorted in shape and had refractile bodies attached to the side. No disintegration of the cytoplasm took place as occurred with the quartz preparations.

Discussion

The cycle of changes produced by ultraviolet irradiation on red blood cells is described. Furthermore, our findings agreed with those of the workers who affirmed that rays capable of causing hemolysis are filtered out by glass. Though, Earle[3] has reported results with visible light similar to the changes described by us, there were variations in the two technics which do not make our findings comparable. He used a hanging drop culture slide which allowed a comparatively large volume of air to be irradiated with the whole blood. Forbes and Daland[5] have shown that ozone is formed when air is irradiated and that this ozone is rapidly absorbed by fluid where it exerts an intensely toxic action on suspended organisms. They also proved that the exclusion of air bubbles prevented ozone formation and that then the direct action of the rays proved lethal. Therefore, the results obtained by

TABLE I

SUMMARY OF EXPOSURES

Kind of Blood.	Irradiations 1st intensity, 4.77×10^5 ergs per second.			Irradiations 2nd intensity, 1.03×10^6 ergs per second.		
	No. of exposures.	Av. time of heomlysis.	Limits of hemolysis.	No. of exposures.	Av. time of hemolysis.	Limits of hemolysis.
HUMAN	6	19.5 min.	12-25 min.	12	10.8 min.	8-16 min.
GUINEA PIG	6	21. min.	17-25 min.	6	10.3 min.	9-14 min.
25 PER CENT SUSPENSION OF GUINEA PIG RED CELLS IN 0.85 PER CENT NaCL.	.....	.....	.....	6	8.5 min.	7-11 min.
FROG	.....	.....	.....	7	21. min.	16-30 min.

Earle may be due to indirect action of the light. We were also able to verify Earle's inability to produce hemolysis with flat preparations. In this laboratory many supravital blood smears have been studied and exposed to the light of an ordinary substage lamp for as long as two hours. These supravital preparations were made in the usual manner. Moreover in preparation of whole blood made on slides free from the dye, there were no signs of hemolysis at any time during the observation. Some cells were distorted and others showed peripheral knobs, evidences of degeneration that were usually attributed to the heat in the microscopic incubator box. Finally, the slight difference in time necessary for the production of hemolysis by the different zones of visible spectra would strengthen the view that the changes were not caused by the direct effect of the light. Bie[6] of the Finsen Institute has shown that the presence of oxygen is necessary to produce changes with light of longer wave lengths while with light of short wave lengths there is a direct action on the cell and the effects were not due to the formation of toxic substances in the medium.

The pigment was gradually liberated by the ultraviolet energy in the early phase of irradiation of the non-nucleated cells without cellular disintegration. As the human and guinea pig cell disappeared from the microscopic field, it was thought that complete disintegration had taken place. However, when the field was viewed with the diaphragm partly closed by light other than the ultraviolet source, the outer wall of the cells were found to be present. The resistance of these ring forms would seem to give further evidence that the human red blood cell has a definite membrane. On the other hand, the solution of the plasma membrane in the frog's red blood cells would indicate no such differentiation of the outer surface as seen in the human and guinea pig cell. This fact is in accord with the observation of investigators working with the micromanipulator who have found that the frog's cytoplasm completely disintegrates after trauma Reznikoff.[7]

The explanation of the mode of hemolysis is still a matter of dispute. There is likewise no uniformity of opinion as to how hemoglobin is held within the corpuscle. Some observers consider that it is a function of a definite cell membrane. Chambers[8] states the human blood cell possesses a surface film which if punctured permits the hemoglobin to diffuse out and to leave behind a transparent glutinous mass. If this is true, then the ultraviolet energy has modified the physico-chemical state of the membrane so that it has become permeable to the hemoglobin.

However, there are many that believe hemoglobin is held in a loose chemical or physical union, presumably the former, within the stroma of the corpuscle and that the various hemolytic agents destroy this union. Ultravio-

TABLE II

PROTOCOL OF SOME OF THE OBSERVATIONS MADE ON HUMAN RED CELLS

SECOND INTENSITY OF BURNER (1.03 x 10⁶ ergs per sec.)

No. of Experiments.	Time of Irradiation	Condition of Irradiated Cells
10	Started at 11:15 a. m.	Cells normal, green opaque, occasional cell with knobs on periphery.
	11:19 a. m.	Some evidence of liberation of pigment.
	11:20 a. m.	Cells beginning to swell and assume various shape. Movement.
	11:22 a. m.	Liberation of pigment marked. Field shows faint greenish tinge. Cells beginning to hemolyze.
	11:25 a. m. Finish	Cells have hemolyzed. Many refractile bodies. Ring and shadow forms remain. Time of hemolysis — 10 minutes.
12	Started at 12:01 p. m.	Some rouleaux formation present.
	12:07 p. m.	Beginning of liberation of pigment. Rouleaux formation destroyed. Swelling and distortion of shapes.
	12:12 p. m.	As the hemolysis increases, the small refractile bodies appear in greater numbers.
	12:17 p. m. Finish	Hemolysis complete. In this observation many of the ring forms have knobs on outside wall. Time — 16 minutes.

let light may be capable of disrupting such a union.

Packard[9] found that paramecia showed an increased permeability after exposure to ultraviolet, and Tchahotine[10] observed that when a narrow pencil of ultraviolet was directed on a sea-urchin's egg, the permeability to water became greatly increased at the point of illumination. Petersen[11] also showed increased permeability of capillaries due to exposure to ultraviolet.

The disappearance of crenation on short exposure to ultraviolet is an interesting phenomenon as it is the first detectable effect of the radiation. It indicates that the exposure has initiated a photochemical reaction, a change that is not evident in the normal cell. The chemical reaction responsible for restoring the cellular equilibrium of crenated human and guinea pig red cells and the irregular frog cells may be analogous to the results obtained by Reznikoff[7] working with a microneedle. He found that a red blood cell injected with lead salts first became crenated and then became perfectly round. He thought of this as analogous to the precipitation of a salt in a solution. When the precipitation is taking place the surface of the solid phase is irregular. When equilibrium is established the interphasial surface is smooth. So a crenated red cell, which may be considered as a cell injured by trauma or unfavorable chemical environment, may be restored to equilibrium with a small amount of ultraviolet irradiation. Further continuous irradiation produces an unstable equilibrium or chemical precipitation until finally disintegration ensues. Barr and Bovie[12] observed similar effects on irradiation of amebae. They have introduced the dimension of time in the organization of protoplasm. For, if the irradiation was carried far enough the molecular organization which had its origin at the colloidal interfaces broke down and cytolysis resulted. The small refractile bodies which appear free in the field and the vacuoles present in the cytoplasm of the frog's erythrocyte are associated with similar bodies seen during degenerative changes preceding death.

To correlate the hemolysis of red cells by ultraviolet energy *in vitro* with results obtained *in vivo* is difficult as the conditions of the experiments are dissimilar. *In vitro* the red cells are studied under artificial conditions while *in vivo* experiments are constantly affected by general reactions. However, many investigators have reported results which may be explained speculatively in terms of these

TABLE III

PROTOCOL OF SOME OF THE OBSERVATIONS MADE ON FROG RED CELLS

SECOND INTENSITY OF BURNER (1.03×10^6 ergs per sec.)

No. of Experiments.	Time of Irradiation	Condition of Irradiated Cells
21	Started at 12:29 p. m.	Oval cells, light green in color, oval nucleus barely visible.
	12:35 p. m.	Cell walls begin to corrugate and become wavy. Refractile, swelling, and movement.
	12:40 p. m.	Refractile areas within cell begin to disappear. Cells become rounded, like human red cell, and the cytoplasm appears a deep green.
	12:45 p. m.	Hemolysis begins — nuclei become more prominent and take polar position.
	12:53 p. m. Finish	As hemolysis continues cytoplasm takes on ground glass appearance. Nuclei with chromatin granules remain in field at end of hemolysis. Time for hemolysis — 24 minutes.
23	Started at 11:35 a. m.	Normal in appearance.
	11:41 a. m.	Walls of cell become wavy and irregular. Small refractile bodies appear within and outer wall of cells. Some cells show extrusion of fine protoplasmic filaments with small knob at end. Swelling and distortion.
	11:47 a. m.	Cells begin to round, hemolysis taking place. Some of the cells agglutinate and fuse during hemolytic stage. Nuclei become prominent.
	11:57 a. m. Finish	Hemolysis completed. Field shows greenish tinge. No shadow forms. Nuclei prominent. Time of hemolysis — 22 minutes.

experiments. Koeppe[13] has demonstrated that samples of children's blood, drawn immediately after a 30 minute irradiation with a quartz mercury vapor lamp, were hemolysed by light much more readily than samples drawn before irradiation. Traugott[14] has shown there is a definite increase of erythrocytes in the blood that is not due to a shifting of the concentration of the plasma. Again, it is tempting to infer that with a moderate dosage of ultraviolet irradiation there is a definite stimulation of hematopoietic centers of the body due to substances released into the blood from the premeable red cells. It is beyond the scope of this paper even to speculate as to the mode of action of ultraviolet in these experiments. We agree that ultraviolet does not penetrate more than a half millimeter into skin, yet as Bovie and Daland[15] pointed out absorption alone cannot be used as a measure of the physiological action, because such action does not depend upon the amount of energy absorbed but upon the kind of processes initiated through the transformation of the absorbed energy.

Conclusions

1. It has been shown that *in vitro* ultraviolet energy produced by a Kromayer lamp can cause hemolysis of red bleed cells.

2. The liberation of pigment from human and guinea erythrocytes was accomplished without the evident rupture of the cells.

3. The cytoplasm of the frog's red blood cell disintegrated completely while the nucleus showed coagulative changes.

4. Under the conditions of these experiments the wave lengths below 300 m.μ were responsible for hemolysis.

For References see page 754.

TUBERCULOUS ENTEROCOLITIS *

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CHICAGO

Tuberculous enterocolitis is primarily a lymph borne disease. While in rare instances the pathology may follow a bacillary embolic blood stream invasion, in a majority of cases the infection is enteral and results from the swallowing of tuberculous infected food or sputum. Those portions of the bowel most abundantly supplied with lymphatic tissue are most frequently involved. Our series of two hundred thirty autopsies on tuberculous cases showed a preponderance of lesions occurring in the terminal ileum, on the ileal side of the ileo-cecal valve, and at a point in the cecum where the food current strikes the cecal wall.

TABLE I

FINDINGS IN THE GASTROINTESTINAL TRACT OF PATIENTS WHO DIED OF PULMONARY TUBERCULOSIS

		Per cent
Total number of autopsies	230	
Number having ulcerative enterocolitis	184	80.0
Severe lesions	119	51.8
Lesions from stomach to rectum	1	0.4
Lesions from duodenum to rectum	6	2.6
Lesions from jejunum to sigmoid or rectum	39	17.0
Lesions from upper ileum to sigmoid or rectum	30	13.0
Lesions from midileum to transverse colon	43	18.7
Total	119	51.8
Early and unusual lesions	65	28.2
Ulcers in the ileum only	11	4.8
Superficial	7	
Deep	4	
Ulcers in the cecum only	13	5.7
Superficial	8	
Deep	5	
Ulcers in the colon only	1	0.4
Ulcers in the ileocecal valve only	4	1.8
Ulcers in the appendix only	2	0.8
Ulcers in the cecum and colon only	12	5.2
Ulcers in the ileum, appendix and cecum only	5	2.1
Ulcers in the ileum and appendix	3	1.3
Ulcers in appendix and cecum	3	1.3
Ulcers in ileum and cecum	11	4.8
Total	65	28.2

TABLE II

TUBERCULOUS LESIONS OF DIFFERENT PORTIONS OF THE GASTROINTESTINAL TRACT

Tongue	1	0.6
Stomach	1	0.6
Duodenum	7	3.8
Jejunum	39	21.2
Ileum	153	83.2
Cecum	160	87.0
Appendix (not counting 14 missing)	72	39.1
Colon	132	71.7
Sigmoid and rectum	30	16.3

The portions of the intestine especially susceptible to tubercle invasion are those segments which are associated with physiologic decrease in the rate of flow of intestinal content. Normally there are differences in the physiologic function of the ileum and the large bowel. As small bowel contents approach the terminal ileum, the process of food absorption gradually diminishes and the progress rate changes. Through the function of the ileocecal valve, the powerful colonward push of the ileac contents is controlled. The contents of the small intestine then pass in a regular fashion into the cecum. Through the control of the neuromuscular mechanism at the ileocecal valve and in the cecum, the cecum is able, through its co-ordinated diastoles and systoles, to perform two functions: first, the equalization of the pressure push of the terminal ileum to the relatively lower intra-cecal pressure, and, second, the initiation of the peculiar haustral and segmental mass motion of the colon.

To summarize, then, we see in the neighborhood of the ileocecal valve a composite picture, each feature of which seems to influence implantation in this region. In this region absorption is still active, the food and sputum have been thoroughly digested, thus releasing bacilli, the contact of the contaminated residue with the mucous membrane is prolonged, the acid reaction of chyme has become alkaline, and the amount of lymphatic tissue present is increased. These are some of the facts which seem to indicate that the tuberculous process, as a rule, starts in the neighborhood of the ileocecal valve.

Pre-existing intestinal derangement, super alimentation, lack of enzymatic action particularly that of the lipases and trypases, and vitamin imbalances are apparently all factors in aiding the inception of this disease.

Pathological Types

The classification that can be followed with greater ease is based on the sequential development of the pathology and is as follows:

1. Ulcerative.
2. Sclerotic or Fibrous.
3. Hypertrophic or Hyperplastic.

Ulcerative Type: The ulcerative type is the most frequent, and its manifestations are protean. The early lesions occur in the solitary follicles or Peyer's patches. In young individuals hyperemia and hyperplasia occur and the picture resembles grossly that of Typhoid.

* Read at the Tenth Annual Meeting of the American Congress of Physical Therapy, October 6, 1931.

As the lesions extend following the lymph channels circumventing the bowel through the submucosa an undermining of the edges of the mucosa results. The mucosa in many places sloughs, leaving a ragged ulcer with bridges of intact tissue and a necrotic floor made up of dense, circular muscular fibers with granulating tissue. Deeper invasion of the ulcer may occur limited by the serosa, or adhesions to adjacent viscera may wall off a penetrating lesion. Coalescence of adjacent lesions may create ulcers, which lie transversely, diagonally or in a longitudinal direction.

Sclerotic or Fibrous Type: This type is secondary to the ulcerative lesions and results from a great increase of the connective tissue. Cicatrization and stenosis of the bowel lumen results.

Hypertrophic or Hyperplastic Type: This type is supposedly due to tubercle bacilli of attenuated virulence. A tumor massis formed most frequently located in the cecum. The essential change is a proliferation of the connective tissue involving all of the layers of the bowel.

Healing: Tuberculous ulceration of the bowels evidences a distinct tendency toward healing as demonstrated by the formation of connective tissue and scar. Partially or completely healed lesions have been seen in our series. Where the lesion has been superficial, involving only the mucosa, healing may result without cicatrization being evident.

The progression of the healing process will, of course, depend on the stage of ulceration and other factors. Regeneration of the mucosa and connective tissue elements occurs in various proportions. There may be regeneration and repair on one side of the ulcer and a continuation of the destructive process on the other. There may also be evidence of regeneration in one lesion and caseation in an adjacent lesion.

Symptoms

The symptoms of intestinal tuberculosis may be slight and as difficult to appreciate clinically as the symptoms of early pulmonary tuberculosis. There is frequently no parallelism between the severity of the extent of the pathologic lesion and the severity of the symptoms. No symptoms referable to the bowel may be noted even though extensive intestinal disease is present. On the other hand, marked evidence of gastrointestinal upset may be apparent in cases in which the pathologic lesion is comparatively slight.

Occasionally the presence of a co-existent pulmonary tuberculous lesion obscures the intestinal clinical syndrome. Intestinal tuberculosis of the severer type is more common in the latter stages of pulmonary disease. There is already present the wide-reaching and variable syndrome due to this pulmonary pathology. Naturally under such circumstances, it is difficult to clearly delineate the symptoms due to the intestinal lesion. The symptoms which we might attribute to ulceration of the bowel might readily be due to pulmonary tuberculous toxemia, and on the other hand, symptoms which we suppose pulmonary toxemic may, as a matter of fact, be the result of enterocolitis of greater or less severity.

In considering the general clinical picture, we must strive to avoid dogmatism. It is a mistake to place too much reliance on any one symptom. It is only by means of a careful survey of the entire clinical syndrome, assisted by the Roentgen-ray and other laboratory measures, that we can hope to arrive at any degree of accuracy in this condition.

Pain and Tenderness are neither constant nor characteristic. It may be entirely absent or may be so slight that the patient whose attention is more devoted to his pulmonary symptoms will not complain. Pain may occur anywhere in the abdomen, particularly in the right lower quadrant, frequently in the epigastrium which is usually worse after meals. Sensitiveness to pressure is frequently present, particularly in the ileocecal region.

Diarrhea and Constipation: The diarrhea is apt to be spasmodic, and occurs at irregular intervals. It may be very profuse, thin and watery. On the other hand, the diarrhea may be quite mild, i. e., two or three bowel movements a day. Blood, mucous and tissue shreds are frequently present, but are not characteristic. Nocturnal diarrhea is more common in intestinal tuberculosis.

The dysenteric type of diarrhea is not infrequent and is accompanied by tenesmus, glairy, mucopurulent or bloody stools and a greatly increased number of movements. Prolapse of the rectum is occasionally seen. Constipation of varying degree is noted in an appreciable number of cases. It is to some degree, an indication of ileocecal involvement.

Alternating diarrhea and constipation is not infrequent.

Other Gastrointestinal Symptoms: Distress after eating, hyperacidity, acid eructations, gas, nausea vomiting and flatulence are frequently noted. In advanced cases, marked abdominal distention is seen and the bloated abdominal contour imparts a peculiar, generalized, "doughy" feel to the hand on palpation. In our series, free peritoneal exudate complicated 40 per cent of the cases. In the advanced cases, also, deep abdominal palpation (which is not always practical owing to distention) revealed stiff, indurated loops of bowel, not rarely enmeshed in the thickened omentum.

Muscle Spasm: Muscle spasm should be looked for carefully in conjunction with the symptoms, particularly in the ileocecal region. This sign is of more value in patients whose abdominal muscles, owing to protracted disease, have not suffered degeneration.

Loss of Weight: Serious extension of the intestinal lesion determines marked and progressive loss of weight. Cases accompanied by profuse diarrhea, by anorexia and perhaps nausea and vomiting, lose at an alarming rate. Eight or ten pounds a week may be lost, and the prognosis becomes grave. Ordinarily it is difficult to decide what proportion of the loss of weight must be attributed to the intestinal lesion and what proportion to the contemporaneous pulmonary condition.

Intestinal Hemorrhage: Severe intestinal hemorrhage is rare. Nevertheless, fatal cases have occurred. The evolution of the ulcer explains the rarity of severe hemorrhage. Obliterating endarteritis in the slightly progressive lesion, gradually closes off the vessels.

Temperature: There is nothing definitely distinctive as regards temperature which may be attributed to intestinal tuberculosis. Occasionally a rise in temperature may be noted in a patient who shows no aggravation of pulmonary findings. Such a rise in temperature otherwise accounted for, should draw attention to the possibility of intestinal tuberculosis.

General Symptoms: Depression and melancholic states are rather common, in contrast to the pulmonary patient who is inclined to be optimistic. The patient troubled with abdominal distress is inclined to be distinctly pessimistic. Dissatisfaction, irritability and nervousness are rather common.

Course: For reasons already stated, it is futile to attempt to define the course in terms of accuracy. If we are not in a position to discover the exact time of onset, we can hardly say anything very definite concerning the duration of the condition.

The course, however, is not universally and inevitably downward. When we speak of intestinal tuberculosis as a condition occurring shortly before death, we have in mind advanced intestinal tuberculosis. Severe, rapidly progressive intestinal tuberculosis offers a gloomy prognosis and the patient's life span may be measused in months or weeks.

Not all cases, however, are of this type. There are undoubtedly many cases of intestinal tuberculosis *that recover,* in the same way that there are many cases of intestinal tuberculosis that remain undiagnosed. Pathological studies show clearly that healing can and does take place. In milder involvement, the healing may even occur without leaving any great evidence of the former lesion. The point I wish to stress is that the course of intestinal tuberculosis must not be measured in terms of the final stage of severe cases of bowel tuberculosis.

The complications may be best shown as they occur post-mortem in the following table:

TABLE III
COMPLICATIONS OF TUBERCULOUS ENTEROCOLITIS

	No.	Per cent
Oesophageal fistulae	2	1.1
Peptic ulcers	8	4.3
Stomach	6	
Duodenum	2	
Perforations	15	8.2
Ileum	9	
Appendix to bladder	2	
Appendix to sigmoid	1	
Appendix to ileum	2	
Appendix to body wall	1	
Fecal fistulae	5	2.7
Peritonitis without perforations	7	3.8
Obliterative	3	
General	4	
Diverticula	6	3.3
Meckel's (2 with tuberculosis)	3	
Duodenal	1	
Cecal	1	
Ileal	1	
Stenosis of Colon	2	1.1
Ileus (strangulation due to adhesions)	1	0.6
Spastic colon	38	20.7
Tabes mesenterica	42	22.8

Diagnosis

As in pulmonary tuberculosis, early diagnosis in intestinal tuberculosis is the keystone of the prognostic arch. The diagnosis of this condition which in the past has been considered notoriously difficult, has received considerable impetus through the roentgenologic research of Brown & Sampson[3] in this particular field. The extreme spastic irritability of the terminal ileum and the proximal colon found in early tuberculous lesions as pointed

out by these workers, is a most important diagnostic criterion. A careful study of the symptoms as indicated above in a majority of instances will furnish the additional information necessary to make certain the presence of tuberculous enterocolitis. In the hypertrophic type one should not forget the pesence of the tumor mass, round or elongated, in the ileocecal region.

Differential Diagnosis

In discussing differential diagnosis I shall merely mention a few conditions which may possibly be confused with tuberculous enterocolitis.

Mucous Colitis.—Mucous colitis is particularly liable to cause difficulty. Many of the patients suffering from this condition are undernourished, anemic, neurotic and present signs suggestive of minimal tuberculosis. A thorough examination into the family history, x-ray investigation of both lungs and intestinal tract, and repeated examination of sputum and feces for bacilli may be necessary before a conclusion can be reached.

Malignancy of the Intestinal Tract.—Constipation, or constipation alternating with diarrhea, marked loss of weight and general weakness may present a picture closely simulating that of intestinal tuberculosis. If, in addition, there should be an old tuberculous lesion, the problem is indeed complicated. The absence of fever, the absence of serious pulmonary symptoms and the x-ray will be helpful factors in establishing the diagnosis.

Amebic Dysentery.—The loss of weight and the diarrhea associated with amebic dysentery may cause confusion. The presence of the characteristic organism in the feces, however, should establish the diagnosis.

Nontuberculous Enterolocitis.—This is one of the most difficult conditions to eliminate. Many tuberculous individuals have gastrointestinal symptoms which seem referable to the tuberculous toxemia alone. Only prolonged study and a careful x-ray examination will determine the diagnosis in such cases.

Acute Appendicitis.—Ileac tuberculosis may be mistaken for acute appendicitis. The well localized pain, tenderness, constipation, and fever may lead to confusion. However, the course of the disease, the presence of tuberculous lesion in the lung and the chronicity of the course will determine the diagnosis.

An acute appendicitis, superimposed upon a tuberculous enterocolitis, has been seen in a number of instances and has created considerable diagnostic difficulty. Such patients having been under continuous supervision, the change in the leukocytic curve was observed to tend upward. That, plus clinical intuition and judgment should result in the proper diagnosis.

Chronic Appendicitis.—The recurrent attacks of pain, the tumor mass in the cecal region, slight fever and gastrointestinal symptoms may cause ileocecal tuberculosis to be mistaken for a chronic recurrent appendicitis.

The history, the presence of the pulmonary lesion, the low leukocyte count, the presence of blood or pus and bacilli in the stools, and the x-ray will usually establish the diagnosis.

Nontuberculous Cecal Lesion.—Nontuberculous cecal lesion such as diverticulitis, syphilis, and carcinoma may be mistaken for cecal tuberculosis. The history, blood test, x-ray and the absence of a primary tuberculous lesion will usually rule out tuberculosis.

Spastic Colitis.—A spastic colon may be mistaken for a tuberculous obstructive lesion, or vice versa. The administration of atropine may be resorted to, to settle the diagnosis in this case. After a dose of atropine in the case of spastic obstruction, the barium meal may be seen to pass the site of obstruction. In mechanical obstruction, due to secondary cicatrization, the barium meal does not pass the site of obstruction even after atropine has been given.

Diagnosis of Location.—This is difficult either by clinical examination or x-ray. A lesion may be evident by x-ray in the cecum, or a tumor mass may be felt clinically in this location. On these findings, supported by other evidence, a diagnosis of ileocecal tuberculosis may be made. The findings, however, give no evidence of the extent of the disease. Extensive disease of the ileum, or even of the colon, may be contemporaneously present. It is said that constipation occurs the more often in tuberculosis of the ileum; that diarrhea or alternating attacks

of diarrhea and constipation occur more often in tuberculosis of the ileocecal region or of the cecum. As regards the colon, a lesion in the proximal half of the large intestine is more apt to be tuberculous.

General Considerations

It may not be amiss to draw attention to a few general considerations in the differential diagnosis. In the first place, we must remember that the presence of a contemporaneous pulmonary lesion is presumable and not conclusive evidence. If, for instance, we note by x-ray, or otherwise, a lesion in the intestinal tract we are not compelled to the conclusion that the lesion is tuberculous simply because a pulmonary lesion also exists. It is quite possible that carcinoma of the intestinal tract may develop in a patient suffering from pulmonary tuberculosis. In fact, this complication does at times occur and is mistaken for tuberculosis of the bowel.

As a converse position to this, we cannot rule out tuberculosis of the bowel merely because a tuberculous lung lesion is not clinically or roentgenologically apparent. A tuberculous bowel lesion may occur even when clinical and x-ray examinations give no indication of pulmonary tuberculosis, and even when the postmortem examination reveals, if anything, merely an old, fibrous, apical scar.

It must be remembered, also, that the filling defect and the lack of barium shadow in the cecum and ascending colon are not definitely characteristic of a tuberculous process. This same phenomenon may be noted in malignancy of the cecum and in ulcerative colitis.

Prognosis

The outlook in the severe cases of intestinal tuberculosis, complicating an advanced stage of pulmonary tuberculosis, is unquestionably serious. True, by heliotherapy and other measures, for even such cases, an improvement or a prolongation of life may be looked for. Even in the face of a rapidly advancing pulmonary condition, the intestinal lesion, under suitable treatment may possibly heal. The advantage thus gained, however, is lost through the progress in the pulmonary lesion. The high lights in the prognosis are to make the diagnosis of both the intestinal lesion and the pulmonary lesion in the early stage, when such lesions are still curable. Healed intestinal tuberculosis is probably much more frequent than we suppose. If large, ulcerating areas may heal, it is rational to suppose that small areas and minute tuberculous erosions would heal all the more promptly. The prognosis, then, in essence, depends on early diagnosis; the earlier the recognition of the condition, the better the prognosis. If the pulmonary lesion is incipient or moderately advanced, if the intestinal lesion is not too extensive, the case, under suitable treatment—heliotherapy, x-ray, perhaps surgery—may be said, on the whole, to have a fair prognosis. Probably in the future, routine barium meals and careful examination and observation will disclose the presence of early intestinal disease in many cases of incipient tuberculosis.

The prognosis in such cases, under suitable management, may be said to be almost as good as the prognosis in incipient tuberculosis uncomplicated by intestinal ulcers. It is my impression that the early ulcer reacts well to treatment, and should not, if properly handled, influence the outlook in a definitely unfavorable direction.

Treatment

Rest.—Both physical and psychical rest are absolutely essential. Exercise with its tendency to increase peristalsis, is inadvisable in patients with symptoms of intestinal tuberculosis. Rest should imply complete bed rest and relaxation.

Diet.—It should be our basic aim to have the food ration consist of a balanced proportion of fats, carbohydrates, proteins and minerals, and in addition to see that an adequate supply of vitamines is furnished. The diet should be so arranged that the residue remaining after absorption is scant. Caution must be directed against over-feeding. Tremendous food intake throws a great burden on the patient's ailmentary tract from the secretory and motor aspects, with a consequent loss of intestinal quietude. The vitamin content should be most carefully guarded, particularly as pointed out by McConkey. There should be an adequate amount of vitamin furnished through the medium of cod liver oil with tomato or orange juice. The improvement consequent on the taking of these substances even as in heliotherapeutic procedure can be largely ascribed to improved calcium metabolic function.

Ultraviolet Therapy

Ultraviolet Therapy.—Either natural or ar-

tificial, as above mentioned, acts principally through its effect upon the calcium metabolism in the body and should always be used as an adjunct in the treatment of tuberculous enterocolitis. There are some authorities who claim very little benefit from this procedure. Rollier, however, has for years advised heliotherapy in intestinal tuberculosis. In recent years Brown and Sampson, Forster, Mayer and others, report exceedingly favorable results from the procedure. The tabulation below covers the results of 209 cases studied in Saranac Lake Village:

	Ultraviolet-ray Treatment		No Ultraviolet-ray Treatment	
	Living	Dead	Living	Dead
Minimal	2	0	0	0
Moderately advanced	63 (77%)	19 (23%)	1 (8%)	11 (92%)
Far advanced	51 (53%)	45 (47%)	4 (24%)	13 (76%)
	116	64	5	24

Of 209 cases, 180 were treated by heliotherapy, and of these 116, 65 per cent are living and 35 per cent dead at the time of the report. Of the 29 cases receiving no ultraviolet treatment, 5, 17 per cent, were living, and 24, 83 per cent, were dead. The tabulation shows the figures arranged according to the stage of the disease: minimal, moderately advanced and far advanced.

The use of ultraviolet therapy should be carefully controlled depending upon the type of pulmonary lesion, the presence or absence of a marked febrile course, the reaction of the skin, the susceptibility and idiosyncrasy to this form of treatment. Natural and artificial ultraviolet should be used interchangeably dependent on weather conditions.

Pneumoperitoneum.—This form of treatment utilizing oxygen injections into the peritoneal cavity has not proven of much value.

Surgical Treatment.—The role of surgery in intestinal tuberculosis is a much discussed and unsettled one. Some authorities are inclined to be ultra-conservative and deny to surgery any role of significance except in the presence of complications, as stenosis, obstruction or perforation. Others, especially since the pioneer work of Archibald, claim that life can be prolonged and symptoms ameliorated, or that even definite cure can be established by properly conducted surgical measures in selected cases.

The operations used, are ileosotmy; resection of the diseased bowel with anastomosis; unilateral or bilateral exclusion or short-circuiting; appendicectomy with irrigation and lavage, and resection of cecum.

As regards indications, the following may be tentatively quoted:

1. Cicatricose stenosis of the bowel, of progressive character.
2. The hyperplastic type of cecal tuberculosis, which as stated, is usually associated with a mild tuberculous lesion.
3. Localized abscesses or a tuberculous appendicitis.
4. Perforation.
5. Such localized conditions as rectal abscess or fecal fistula.
6. Intestinal tuberculosis definitely located and not too extensive in the presence of an unprogressive pulmonary lesion.

Surgical Contra-Indications.—

1. Extensively disseminated intestinal tuberculosis.
2. Associated disease of serious nature.
3. A rapidly progressing lung lesion.

Symptomatic Treatment

Constipation.—Constipation, particularly in early tuberculous enterocolitis may be relieved by the use of liquid petrolatum. A one ounce (30 cc.) dose may be given from four to six times daily. The liquid petrolatum acts as a protectant to the ulcerated mucosa and this protection may be significant with regard to healing, not only by preventing trauma from intestinal contents, but also by quieting spasms. Castor oil, if agreeable to the patient may also be given.

Diarrhea.—The control of diarrhea is most important, but, unfortunately, also most difficult. In the late stages, profuse diarrhea constitutes quite a problem. The exhibition of 60 grains (4 gm.) of bismuth subgallate, in a small quantity of hot water after each bowel movement, frequently proves helpful. Given in this way the continuance of the dosage is automatically regulated. Severe diarrhea not controlled by these measures, is managed, commonly, by the exhibition of opium, and by bowel irrigations carefully given once or twice daily; physiologic solution of sodium chloride is used at a temperature of 105 degrees F. In some instances, irrigations with solution of silver nitrate (1:2,000), tannic acid (1:1,000) or mercurchrome—220 soluble (1:5,000), at a temperature of 105 degrees F. prove helpful. Castor oil in half ounce doses is frequently effective, and brings considerable relief.

Calcium chloride, given intravenously in 5 per cent solution or calcium gluconate intravenously is often remarkably effective in checking the diarrhea. Most authorities find that 5 cc. of a 5 per cent solution is about the optimum dosage once or twice a week. Calcium may be given by mouth, in the form of lime water, or as calcium lactate or calcium gluconate.

Among the astringents tannigen in 10 grain doses three times a day, and tannalbin in 5 grain doses, may be used.

Pain.—For colicky pain, atropine cautiously given is some times effective. Hyoscyamus is some times indicated. Hot fomentations to the abdomen, or turpentine stupes will some times help. Heliotherapy will frequently be remarkably effective in reducing pain and discomfort. Calcium salts, particularly by the intravenous or intramuscular route, seem to have the same effect.

Other Gastrointestinal Disturbances.—It is futile to try to cover in detail the symptomatic treatment of the various other gastrointestinal upsets. The gastrointestinal disturbances rest on a pathologic basis, and as long as ulceration remains it is futile to expect much amelioration from purely symptomatic treatment.

Conclusions

1. Tuberculous enterocolitis, as most other forms of tuberculosis, is a lymph borne disease and has such as a predeliction for those portions of the bowel more abundantly supplied with lymphatic tissue.

2. Prophylaxis, as practiced in the prevention of swallowing both infected sputum and food, should receive greater attention.

3. The diagnosis of tuberculous enterocolitis in its early stages should call for intestinal roentgenography at the first itimation of of a gastro-intestinal upset and such roentgen studies should be repeated on recurrence of symptomatic manifestations where negative findings originally were obtained.

4. The prognosis is not as grave as previously considered, especially in the presence of a pulmonary tuberculosis, which can be controlled. The prognosis is definitely improved by the detection of the intestinal lesion in its inception, and through the use of modern therapy.

5. Treatment should be considered in its newer and wider scope. The properly balanced non-residue vitamin mineral salt diet should be supplied. Ultraviolet therapy is a most important adjunct. There are definite indications which at times point out the usefulness of surgery.

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Discussions

Dr. G. D. Kettelkamp (St. Louis, Mo.): There are just a few points which I would like to emphasize which Dr. Goldberg has brought out in this extremely comprehensive paper, even though limited to so short a time. One point he mentioned was the fact that tuberculosis of the intestine is more than a local condition. He mentioned the work of McConklin and Smith, which pointed out constitutional deficiencies as predisposing factors in the development of tuberculous enteritis. These deficiencies were created by a deprivation of vitamins in the feeding of guinea pigs which allowed a greater incidence of tuberculous enteritis than guinea pigs used as controls and given the same dosage of tubercle bacilli.

While the death rate in tuberculous enteritis is as yet very high, due to the fact that many cases of this disease occur as terminal conditions, I personally believe that in every instance the lack of ability of these ulcers to heal is associated with the lack of sufficient vitamin balance in the bodies of the patients so involved. I also agree with Dr. Goldberg that tuberculous enteritis does not make necessary a grave prognosis in every instance.

I remember one case associated with an active tuberculosis of the lung. This patient's pulmonary disease was controlled by artificial pneumothorax with the improvement of the pulmonary condition by the utilization of ultraviolet therapy. Complete recovery resulted so that after two years she was entirely free from gastrointestinal symptoms, and negative as to any ulcerative processes as evidenced in the gastrointestinal roentgenograms. This patient subsequently entered training as a nurse, her diseased lung was allowed to re-expand, and, last August, when migrating to the east, she entered training at the Trudeau Sanitarium. Other similar cases have occurred in patients under observation. I believe that the tuberculous enteritis in itself should not receive the serious consideration, but rather, the constitutional deficiency which arises.

and which constitutional deficiency can be improved by the use of such agencies as tomato juice, cod liver oil, ultraviolet therapy and other measures.

Dr. G. J. Warnshuis (Cedarburg, Wis.): What value do you place on the tuberculin test as a means of early diagnosis?

Dr. C. D. Nelson (Persia, Ia.): What is the relation subject to the miliary tuberculosis of the peritoneum?

Dr. Benjamin Goldberg (Closing discussion): Occasionally, tuberculous enterocolitis may be the result of an embolic invasion of the blood stream, following the rupture of a caseous tuberculous process into a blood vessel. In such instances, a miliary tuberculosis is created which is usually generalized throughout the body. In other instances associated with a tabes mesenterica, a peritoneal miliary tuberculosis may occur, or where a caseous mesenteric gland ruptures, a diffused tuberculous peritonitis may follow.

I was very much pleased to hear Dr. Kettelkamp bring into his discussion the subject of constitutional deficiency as a factor in tubercle implantation and resulting tuberculous lesions in the various tissues of the body. For a number of years, we have done research on the imbalancing of diets to increase or decrease resistance in tuberculosis, and I feel that it is the resultant change in bodily chemistry influenced by such dietary imbalance that Dr. Kettelkamp has reference to.

It was found that a certain fixed formula allowed a maintenance of resistance which was termed a normal balance. This normal balance in animals under complete control was varied through the increase or decrease of the vital body elements with a consequent loss of resistance of such animals to innoculation with tubercle bacilli and subsequent development of tuberculosis following innoculation. The disease could be held in abeyance and, in some instances, a restoration of the tissue to normal occurred with a return to normal balance. The greatest improvement seemed to be derived from the administration of such substances as cod liver oil, orange juice, tomato juice and calcium. The stabilization of the body to increased resistance seemed to be largely a matter of vitamin D efficiency in increasing the absorption of calcium into the body and the deposition of such calcium in the body tissues where improved bacteriocidal action resulted.

As to the value of tuberculin in the early diagnosis of tuberculosis, there are several factors that must be given consideration. As a diagnostic agent, tuberculin is not absolutely specific. The factors that must be considered in tuberculin testing are, first, the selection of a potent tuberculin; second, the presence of allergy. In discussing allergy, we must not forget that allergy which results from infection with tubercle bacilli may be lost later in life even when previously present with active tuberculosis. Allergy may also be found to disappear in the presence of acute exanthematous eruption, grave tuberculosis, or other moribund conditions. The third factor to be considered in tuberculin testing is the mode of application of tuberculin to or into the body tissues from which point absorption, slow, or fast, may take place to produce the reaction. The fourth factor we must consider is the various tests which consist of:—the cutaneous tests, of which there are (a) Moro, a 50 per cent old tuberculin in lanolin applied as an ointment with friction to the skin, the absorption being very slow and, in some instances, practically nil with only a small proportion of positives even in the presence of actual disease. (b) the Dermatubin test in which the tuberculin employed is a highly concentrated glycerin mixture, applied by friction to the skin, and, because of the high potency of the tuberculin, giving a high percentage of tuberculin reactions. Then there are the Percutaneous tests, (a) von Pirquet, in which tuberculin is applied to a limited area of scarification, the scarifier being an instrument of standardized size, causing only a superficial abrasion; in this instance absorption is not always consistent through the layers of the dermis, and the number of positive reactions in the presence of tuberculous allergy is somewhat limited, the Mantoux reaction, in which the dilute tuberculin is introduced intradermically and where, because of complete absorption of tuberculin, a high percentage of positive reactions is obtained. This test, because of absorption through the skin, is to be preferred to the subcutaneous test as described by Koch, in which ready absorption takes place. Such ready absorption may occur and result in a three-fold response: a local reaction, an inflammatory areola at the site of innoculation; a focal reaction, an activation of the disease process, causing an increase of exudate at such focus, with a constitutional reaction the result of absorption of toxins due to the activation of the local process.

In pulmonary lesions I have seen grave consequences from such focal reactions following the use of the subcutaneous tuberculin test and have, therefore, discontinued its use except where used as additional evidence in diagnosing a tuberculous process.

As to the value of the test, I repeat, tuberculin is not particularly specific. Calmette has shown in his oral innoculation with tubercle bacilli that a sensitization as manifested by tuberculin testing which has been developed may be lost after a period of six weeks to three months, following the proven presence of such allergy. I have also seen loss of sensitivity to tuberculin in adults with active tuberculosis after such tuberculous processes had been healed for a number of years. The younger the individual, particularly in children who are in good health with a negative tuberculin reaction, the more confirmatory the test as to the absence of tuberculosis. The presence of a positive reaction does not of necessity indicate disease, but may merely indicate allergy as the result of previous infection with tubercle bacilli.

A THERMOELECTRIC THERMOMETER FOR THE DETERMINATION OF RECTAL TEMPERATURES *

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TUCSON, ARIZONA

In this article we wish to describe a thermoelectric thermometer which has been found to be very satisfactory for the accurate determination of rectal temperatures. We shall discuss certain important principles upon which proper construction is based and present data on the operational characteristics of the device.

The apparatus was designed and constructed at the request of Dr. W. Paul Holbrook, Physician-in-Chief of the Desert Sanatorium, for use during treatments by artificial fever. It was considered by Dr. Holbrook that such a device was desirable for the following reasons: (1) It frequently is difficult during certain stages of the treatment to secure mouth temperatures by mercury thermometer, because of restlessness of the patient; (2) the rectal temperatures may differ significantly from those of the mouth or axilla; and (3) the mercury thermometer is very poorly adapted to the determination of rectal temperatures during the treatments. Our experience with the thermoelectric thermometer has clearly demonstrated that this instrument is admirably suitable for such determinations. Evidently its field of usefulness is not, however limited to observations during artificial fever treatments. In general the instrument can be used as an accurate and convenient substitute for the mercury thermometer under conditions which make the use of the latter impractical.

The use of thermojunctions in the measurement of temperatures in man and animals is not new. But as yet such use has been confined principally to a comparatively small number of experimental studies. The various devices employed have all been built upon the same basic principles discovered more than one hundred years ago. The instrumental design has been varied according to the intended use, the sensitivity desired, etc. It will be unnecessary to review these variations of design at length, particularly since in most cases the apparatus has been designed for the measurement of intra-venous, surface and tissue temperatures, with which we are not concerned at present. Reference to the following representative papers will suffice. Thermocouple needles for use in obtaining the temperatures of tissues and deep-lying organs have been described by Bequerel and Breschet,[4] Lefévre,[10] Holding,[9] Clark,[8] Adrian and Watts,[1] Lewis and Love,[12] Wagner,[15] Bazett and McGlone,[2, 3] and recently (May, 1931), by Sheard.[14] For the design and mounting of thermocouples for measuring surface temperatures we may refer to descriptions by Lewis,[11] Benedict,[5] Bazett and McGlone,[2] Benedict, Koropatchinsky and Finn,[6] and Scott.[13] A thermoelectric element in connection with a Leeds and Northrup electrical recorder is used by Breed[7] for measuring rectal temperatures. Only a very meager description of the device is given. A rectal thermocouple and mounting are described in the recent paper by Sheard.[14] These papers describe various instrumental accessories for indicating the temperature of the cold junction or keeping it constant, for measuring the electromotive force, etc. The present apparatus for measuring rectal temperatures includes a new type of rectal thermojunction and mounting and an assemblage of instrumental parts differing in many respects from those previously described.

As has been stated, the principles of thermoelectric thermometry have long been known and employed. The junction of two dissimilar metals is the seat of an electromotive force whose magnitude is determined by the temperature of the junction and by the thermoelectric properties of the metals composing it. If an electric circuit contains two junctions, oppositely directed, the temperature of one of the junctions may be deduced if the temperature of the other junction and the net electromotive force resulting from their opposed effects are known. A circuit containing dissimilar metals, therefore, may be employed as a thermometer. With proper calibration and use, thermoelectric thermometers are reliable and highly accurate. The size of the sensitive

* From the Laboratories of the Desert Sanatorium and Institute of Research, Tucson, Arizona.

elements and the general design of the apparatus may be varied to suit any of a great variety of conditions under which the determinations may be made. In the measurement of rectal temperatures during diathermy or other forms of treatment by artificial fever, the recording device may be located at any desired distance from the patient and the readings made without in any way disturbing the bed covers or wrappings which serve to insulate the patient against loss of heat.

General Arrangement of Apparatus

The present apparatus was designed to require a rather small amount of space in the treatment room. No attempt was made, however, to build it as compactly as possible. Since the treatments at the Desert Sanatorium usually are given in the same room, it was thought best to build a small, heavy table with the instrumental parts set in the top, the table affording the necessary stability. At the same time the outfit was made sufficienly rugged to be moved about readily without injury to any part of it.

The table, with cover in position over the instruments, is shown in Fig. 1. It is built of 1⅛ in. material, with posts 2½ in. square. The top is 28 in. wide, 18 in. deep and 30 in. high, with front corners rounded to reduce the likelihood of anyone striking them in passing. The cover is about 18 in. long, 9 in. wide and 7 in. high (inside dimensions) and is held in place by three brass lugs fitting into slots in small brass plates set flush in the table top. (See Fig. 2.) The two lugs at one end are curved so that the opposite end must be raised first in removing the cover. The legs carry flat rubber pads on the lower ends.

The instrumental assemblage is shown in Fig. 2. The rectal device A, made of bakelite, carries one of two copper-constantan thermojunctions. The construction of this will be described in detail later. A 6-ft. length of heavy rubber tubing B (tubing made for high-vacuum work) with ¼ in. bore and walls 3/16 in. thick encloses the wires leading from A and forms an adequate protection for them. The wires are several inches longer than the tubing, so that the latter may be accidently stretched without breaking the wires. The tubing passes through the table top and connects with a glass "T" (not visible in Fig. 2), to the other two arms of which small rubber tubes are atached. The copper wire passes through one of these small tubes to the terminals of the millivoltmeter V and back again to the "T." It then accompanies the constantan wire through the second small tube to the glass tube G and thence into a water bath in the Dewar flask F. This flask sits in a wooden box extending below the table top and is held in position by a screw with cork-tipped swivel end bearing against its side wall, the opposite wall resting against cleats with concave surfaces. In the water bath the wires are joined by soldering to form the second thermojunction. This is the "cold" junction, the temperature of which is indicated by an accurate mercury thermometer T with bulb immersed in the water bath. The temperature of the bath is raised initially to the desired point by an electric heater H which extends through the stopper of the flask. No provision is made for keeping the temperature constant, the thermometer being read at each determination of rectal temperature. The heater H is held permanently in position by clamps attached to post P. The current is controlled by a switch at the end of the table. (See Fig. 1.) A stirrer S is used while the water is being heated. There is a small rod R for measuring the water-level in the flask without removing the stopper, by removing the thermometer and inserting the rod. The thermometer is removed and inserted through a hole E in the top of the table when not in use (shown in this position in Fig. 1), since the length of the thermometer here chosen would have necessitated a much higher cover box if left in the flask.

Details of Construction

In designing the rectal insertion rod A with its thermojunction, it was realized that accurate temperature readings could be secured only by means of a device fulfilling the following conditions: good thermal contact between the thermojunction and the tissues must be assured; the heat capacity of the inserted end must not be high enough to cause a significant time lag in the temperature readings; and the junction must be protected against appreciable heat loss by conduction along the wires or through the supporting tube or rod. Besides these conditions, it was necessary that the end which is inserted be insulated against the action of intestinal fluids and so constructed as to be uninjured when subjected to some simple method of sterilization. These conditions have been realized in the present design.

Fig. 1. Table, with cover in position over thermoelectric apparatus.

Details of construction of the rod and thermoelement are shown in Fig. 3. A bakelite tube T ("formica" rolled tubing, made of paper and bakelite) about 23 cm. long, with outside and inside diameters of 8.0 and 4.7 mm., respectively, is fitted with an olive-shaped end piece E made from bakelite rod. Bakelite was chosen because of its great mechanical strength, lightness of weight, and low thermal and electrical conductivities. The end of the tube T fits closely in a hole drilled to a depth of 12 mm. in the enlarged end E. Cement ("Duco household cement," manufactured by the Du Pont Powder Co.) is used to prevent E from slipping off the tube. The enlarged section H (see also Fig. 2), serving as a handhold, is made by slipping a tubular length of bakelite onto T and cementing it in place.

The copper-constantan thermojunction J is located about 5 mm. from the beginning of the enlarged end E. It is soldered to a copper strip S, S, the ends of the wires resting in transverse narrow file cuts which join at the position of the junction. (A single cut would be sufficient.) The top of the junction is flush with the surface of the copper strip. This strip may be considered as a part of the thermojunction. Its purpose is to insure good thermal contact between the junction and the tissues, an important consideration if the temperature indications are to follow the rectal temperatures quickly and accurately. Because of the high thermal conductivity of the copper and the very low conductivity of the bakelite in contact with it, heat imparted to any portion of the strip is conducted rapidly to the thermojunction. At the same time, the amount of copper involved (0.4 g.) is too small to cause an appreciable time lag in the temperature indications, the heat capacity of the strip being only 0.04 cal. per degree C. The bulbous end E is inserted just beyond the anus, the sphincter closing about the rod over the thermojunction and the turns of wire above it. It is believed that the probability of good thermal contact is better with the junction and copper strip in this position than if they were inserted farther, not only because of the tendency of the pressure exerted by the sphincter to insure good contact but because the thermo-elements might be separated from the wall of the colon by feces if farther from the anus. The copper strip is about 2.8 mm. wide, 0.8 mm. thick and 21 mm. long. It has a beveled edge, being wider at the bottom surface, and is bent to conform with the contour

Fig. 2. Instrumental assemblage.

of the surface of the longitudinal section of E, as shown. It is slipped into a channel in E which fits it closely, before E is put in place on the end of T. A corresponding channel in T receives the straight section of the strip at the time E is slipped into place. The same cement used to unite E and T is used under the strip also. The upper surface of the strip is smoothed off so as to be continuous with the surface of the bakelite at every point.

The copper and constantan wires W, W, which form the thermojunction J are gauge No. 28 B. and S., 0.32 mm. in diameter. Each makes three complete turns around the tube T, as shown, before passing through small holes to the inside of the tube. The wires lie in narrow spiral grooves 2 mm. apart, filed in the surface of T. The depth of the grooves is the same as the diameter of the wires, so that the top surfaces of the latter are flush with the surface of the tube. The purpose of the three turns is to reduce the temperature gradient along the wires by bringing them into thermal contact with the anus and so maintaining them at very nearly the same temperature as that of the junction J. Heat losses from the junction by conduction through the wires are practically eliminated by this arrangement, by which approximately 7.5 cm. of each wire is brought into contact with the tissues. The silk or cotton insulation is removed from the turns of wire up to within 2 or 3 mm. of the holes through which they pass to the interior of the tube.

The entire rod and metal parts are coated with "Duco household cement" to insulate the wires electrically and protect them from chemical action. This cement forms a hard, tough, transparent coating which is unaffected by most ordinary chemical reagents. It is applied by dipping the tube three or four times into a bath of the cement, much thinned with acetone, allowing each coat to dry thoroughly before another is applied. The cement fills the spaces in the spiral grooves along the wires, closes the holes through which the wires pass, and makes a smooth, waterproof covering. Rough spots on the surface are removed by carefully rubbing with very fine emery paper. The coating should be only as thick as is necessary to cover the parts well, as it acts as a thermal insulator.

After use, the tube is cleaned by washing with soap and water, then sterilized by immersing in a germicidal solution. A 5 per cent solution of lysol, acting for 3 min. or longer, has been found to be satisfactory. Neither mercuric chloride solution nor ethyl alcohol should be used. The former corrodes the metal, in spite of the protective coating, while ethyl alcohol slowly dissolves the coating. Sterilization by heat is inadvisable.

The second junction of the copper and constantan wires is located in the water bath in the Dewar flask F, Fig. 2, as stated, entering by means of the glass tube G. This tube extends to within 3 or 3½ in. of the bottom of the flask. The opening at the lower end of the tube is reduced to a hole just large enough to accommodate the two wires. The wires are sealed in by introducing "Duco" cement through a hole in the glass tube a little above the end, after which the upper hole is closed by slipping a short length of tight-fitting rubber tubing over it. The wires are soldered together

about 2 in. below the end of the tube, to form the cold junction. The junction and projecting ends of the wires are electrically insulated by coating with "Duco" cement. The wires are allowed to project about 2 in. from the glass tube in order that they may be at very nearly the same temperature as the junction for this distance. This reduces the temperature gradients along the wires to nearly zero and so practically eliminates the loss of heat from the junction by conduction along the wires. Hence the junction can be assumed to be at exactly the same temperature as the water bath, with entirely negligible error.

The bulb of the thermometer T is at the same level as the thermojunction. This is insured by rubber stops on T and G which rest on the stopper of the flask, as shown. T is an accurate Centigrade thermometer reading to 0.1° C., range 0-50°. We have chosen thermometer No. 9534 manufactured by A. H. Thomas Co. Its accuracy is indicated by the fact that four of these thermometers, chosen at random, were found to agree to within 0.01° C. (estimated) when compared in the range from 33° to 43°. This range includes the various temperatures of the water bath in which T is used.

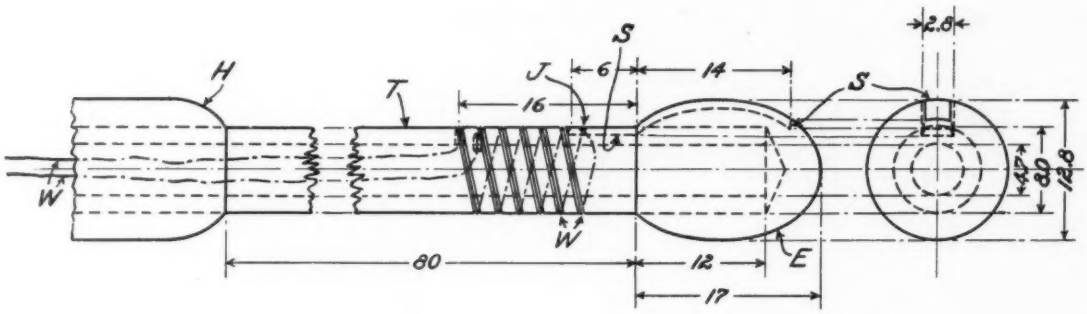
The electric heater H is of the "knife" type, operating on 110 v. and consuming 125 watts. Heater No. 7532, manufactured by the Central Scientific Co., is used here. This heater raises the temperature of the bath, containing about 700 cc. of distilled water, at the rate of 2.4° C. per min. It is operated on the electric lighting circuit.

The stirrer S is made by soldering a length of ⅛ in. brass rod to the center of a perforated brass disk. The rod extends through small circular guide plates fastened to the upper and lower surfaces of the stopper. It is operated by raising and lowering during the time the bath is being heated, to insure that the thermometer indicates the final temperature correctly. It is not necessary to stir at any time after the bath is heated, since it has been found by experiment that although the temperatures at various depths become unequal as the water slowly cools, the temperature is sensibly the same at all points located at the same distance from the surface. Hence the thermometer T, with its bulb near the thermojunction and at the same level, indicates accurately the temperature of the junction, without any preliminary stirring of the water.

A metal Dewar flask was chosen in order to avoid accidental breakage. It is closed by a cork stopper 1¼ in. thick, with holes through it cut to fit closely the inserted instruments. The bath cools much more rapidly than in a similar flask made of glass, actual test showing a loss of temperature of 0.19° C. per hour per degree difference of temperature between bath and room. This means that with a room temperature of 25° C., the bath would cool from 36° C. to 32° C. in about 2.4 hours, or from 36° C. to 28° C. in about 6.8 hours. This rate of cooling is not rapid enough to necessitate heating the water bath the second time during the course of most diathermy treatments, since a change of voltage much greater than that due to a change of temperature of from 36° C. to 28° C. is easily accommodated on the millivoltmeter scale. If the bath must be heated again, this is easily done without interference with the readings. A test has shown that about 1/5 of the heat loss is due to conduction from the water to the outside of the flask through the metal parts of the heater H.

Proper choice of millivoltmeter is important. This instrument should have high voltage sensitivity, yet should not be easily injured by moving or by accidental jarring. The instrument here used is model "SS" manufactured by the Sensitive Research Instrument Corp. The suspension is of a new type which allows an exceptionally high voltage sensitivity yet makes it possible to handle the instrument like the usual portable millivoltmeter. It is provided with three scale ranges, with full-scale readings of 0.4, 2 and 8 millivolts. The 0.4 millivolt scale is used here. This scale has 80 divisions, hence reads to 0.005 millivolt without estimation. The instrument has a resistance of 10 ohms. With the external resistance (about 22 ohms) introduced by the copper and constantan wires in series with it,* a difference of 1° C. between the temperatures of the two junctions produces a reading of 0.01235 millivolts. This corresponds to 2.47 scale divisions. Since tenths of a division can be estimated, temperature readings taken with a reasonable amount of

* Nearly all of this resistance is in the constantan wire. By using a multiple-strand wire or a larger wire for the principal length between junctions, the resistance could be made much lower, with corresponding increase in the effective sensitivity of the millivoltmeter.



All dimensions in mm.

Fig. 3. Details of construction and mounting of rectal thermojunction.

care should be reliable to less than 0.1° C. or roughly to 0.1° F. The relation between voltage and temperature difference is linear over the range covered by the extremes of body temperatures. With the millivoltmeter connected as described, the pointer swings from zero to full deflection in about 30 seconds and is "dead-beat." When the switch (built in the instrument) is opened, the pointer comes to zero reading in about 15 seconds.

One other feature of the electrical circuit should be mentioned. In the thermoelectric measurement of temperature, electromotive forces arising at junctions other than the principal hot and cold junctions must be carefully balanced out or measured. In the present apparatus all unnecessary junctions are eliminated. The junctions at the millivoltmeter terminals, where the copper wires join the brass binding posts, are kept at the same temperature so that their combined effect is negligible. This is accomplished by putting a thick wooden cover over them. The cover was made by drilling a cavity in a solid block of wood large enough to contain both posts. It is held in place by a heavy rubber band and three small projecting pins which fit into holes in the millivoltmeter box. Felt glued to the edges of the cover makes it fit tightly. In this way the binding posts are kept at almost exactly the same temperature and the net thermoelectric effect is practically zero.

Procedure in Determining Rectal Temperatures

With the mililvoltmeter switch open, the water bath in F (Fig. 2) is first heated to about 36° C. by means of the electric heater, stirring while heating. No further stirring is required. The bulbous end of A then is inserted just beyond the anus. After about three minutes the first reading may be made. The millivoltmeter switch is closed and the deflection noted on the 0.4 millivolt scale. The temperature indicated by thermometer T is read immediately afterward. Reference to a calibration curve (straight line), now gives the temperature difference corresponding to the millivoltmeter deflection. This is added to the temperature indicated by T, the result being the rectal temperature.

When a series of readings are to be made at intervals, the millivoltmeter switch is left closed so that a reading may be made at any time without waiting for the pointer to come to full deflection. It is well, however, to check the zero reading occasionally.

When made with a reasonable amount of care, the determinations should be generally reliable to less than 0.1° C. or to about 0.1° F., as has been stated.

Summary

Apparatus for the accurate determination of rectal temperatures thermoelectrically is described. Details of construction are given, together with brief discussions of certain important principles on which the construction is based. The apparatus includes a specially designed thermojunction and mounting for rectal insertion; a very sensitive but portable millivoltmeter; a water bath for the cold junction, contained in a cylindrical metal Dewar flask; an electric heater for the water bath; and an accurate mercury thermometer to indicate the temperature of the cold junction. The instrumental assemblage is permanently mounted in the top of a small, heavy table, which may be moved about without injury to

the apparatus. The procedure followed in securing a temperature reading is simple. The readings are reliable to within about 0.1° F.

The apparatus is particularly well adapted to the obtaining of an extended series of determinations of rectal temperatures without in any way disturbing the patient. It has been tested during the course of treatments by artificial fever and found to be very satisfactory.

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RADIUM THERAPY: ITS SCOPE IN OPHTHALMOLOGY *

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The earliest reference to the use of radium in ocular therapy was in the year 1903. Since then I have been able to index approximately 1,000 references on the use of radium and roentgen ray in ophthalmology. Nearly two-thirds of the articles on radium have appeared in foreign literature.

About seven years ago Broeman addressed a questionnaire to 600 ophthalmologists, dermatologists, and radium therapists, and found only 2 per cent of the ophthalmologists, 1 per cent of the dermatologists, and 3 per cent of the radiologists had used this agent about the eye. Only two or three had ever used it in tuberculosis or pterygium. From these facts it appears that as yet radium is not very extensively used in ophthalmology.

To simplyfy the subject, I have made four groups with the lesions treated in each: Group I. The Andexa: Group II. The Anterior Segment; Group III. The Posterior Segment; Group IV. Miscellaneous, and then take up some of the diseases and conditions of each group in which radium has proved of value. Ninety different benign and malignant disease conditions of the adnexa and anterior segment group, 22 of the posterior segment and at least a half dozen general disease conditions affecting the eye, have responded to radium therapy. One of its largest fields of usefulness is in the treatment of malignant and benign neoplasms of the eye and adnexa. The use of radium avoids mutilating surgery in a most important and conspicuous organ, gives relief from pain, and is easy of application, requiring as a rule, no anaesthetic.

GROUP I. The adnexa comprise (a) the lids and (b) the lacrimal apparatus.

(a) Lids: The lesions treated in this group are: actinomycosis; blastomycosis; blepharitis ulcerosa; essential blepharospasm; chancre; cutaneous horn; eczema; edema; hypertrophy; keloid, lupus vulgaris; mollescum contagiosum; scars; tic convulsif; trichiasis; zeroderma; zanthelasma; angiomata; carcinomata; chlazion; fibroma; leproma; leukemia cutis; lymphoma; moles; mycosis fungoides; nevi; papillomata; sarcomata; verruca.

(b) Lacrimal apparatus; acute and chronic dacryocystitis; fistula of the lacrimal sac; trachoma of the caniliculi and sac; tuberculosis

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of the sac; carcinomata; lymphomata; Mikulicz's disease; papillomata; sarcomata.

GROUP II. The anterior segment includes (c) the conjunctiva, (d) the cornea, (e) sclera, (f) iris, (g) ciliary body.

(c) the conjunctival affections treated are: burns; chancre; chronic catarrhal conjunctivitis; conjunctivitis eczematosa; follicular conjunctivitis; lymphangiectasis; pannus; Parinaud's conjuctivitis; pemphigus; phlyctenular conjunctivitis; pterygium; symblepharon; trachoma; tuberculosis; vernal conjunctivitis; angiomata; carcinomata; lymphoma; papilloma; sarcomata.

(d) The corneal are dystrophies; herpes febrilis; herpes zoster; fistula; keratitis as disciformis, interstitialis, parenchymatosa, profunda, recurrent, rosacea, sclerosing, scrofulosa; keratoconus; leucoma; opacities; pannus; staphyloma; ulcers; tuberculosis; dermoid; carcinomata; sarcomata.

(e) The scleral lesions are episcleritis; scleritis; sarcomata.

(f) and (g) The iris and ciliary body lesions treated are acute and chronic iridocyclitis; sympathetic ophthalmia; tuberculosis of the iris; uveitis; cysts; leproma; sarcomata.

GROUP III. The posterior segment includes (h) the lens, (i) vitreous, (j) choroid, (k) retina, (1) optic nerve, (m) orbit.

(h) The lesions of the lens are anterior polar cataract; incipient cataract; lens haziness and opacities incident to high myopia.

(i) The vitreous is represented by floating opacities and hemorrhages.

(j) The lesions of the choroid are choroiditis; progressive myopia; tuberculosis; sarcomata.

(k) The retinal affections treated with radium are cysticercus; detachment; electric retinitis; retinitis pigmentosa; retinitis proliferans—; retinoblastoma (glioma).

(1) The diseases of the optic nerve are those associated with lesions of the hypophysis and the sphenoid.

(m) The lesions of the orbit are cellulitis; —angiomata; carcinomata; glioma; sarcomata.

GROUP IV. Miscellaneous affections treated with radium are those of a leukemic nature; recent facial paralysis; herpes zoster ophthalmicus; orbital neuralgia; pituitary tumors; lesions of the sphenoid.

Group I. Some Diseases and Conditions of the Adnexa in Which Radium Has Proved of Value

(a) Radium is exceedingly useful in treating affections of the eyelids. It prevents unsightly loss of tissue and deforming scars which are often unavoidable in surgery of this region. Heyerdahl[1] and others report good results in the treatment of *actinomycosis* of the eyelids. De Schweinitz[2] and New and Benedict[3] have used radium successfully in *blastomycosis*. De Schweinitz considers radium superior to surgery in the treatment of many lid conditions. Stubborn cases of *blepharitis ulcerosa* respond well to radium. *Blepharospasm* associated with *conjunctivitis eczematosa*, and *essential blepharospasm* are relieved by mild applications of radium. Likewise tics are benefited. Darier[4] believes it impossible to treat chancre of the lids and conjunctiva successfully without the use of radium. Cutaneous horns have been removed with radium. This method is preferable to surgery since such growths when removed with the knife tend to recur and become malignant. Broeman[5] reports an interesting case of solid edema of the lids entirely relieved by radium. The writer has found it useful in the extensive edema of the conjunctiva and eyelids which frequently occur in fractures at the base of the skull. Lupus and other tuberculous lesions of the eyelids yield well to mild radium applications. Scars and keloids are much softer, and the lid becomes more pliable. In extensive *trichiasis* epilation doses of radium are useful, in the less severe forms the mild doses used in the treatment of *trachoma* will often suffice. There are several reports of the use of radium in the early stages of *xeroderma* and *xanthelasma*.

Tumor formations, nevi and moles of the eyelid offer a wide field of usefulness for this agent. There are numerous reports of the beneficial effects of radium in *angiomata*, particularly the cavernous type. Benign papillomata or warts occurring on the mucocutaneous margin of the eyelids are easily removed by this method. *Chalazions* which return after operation can be dispelled with radium.

Carcinomata of the eyelid, if not too extensive and deep, appear to be favorably affected provided the treatment has been thorough. *Adenocarcinomas* frequently develop on the site of a chalazion. These respond well to

radiotherapy, but I have found them prone to recurrence in latter years. The basal cell type *rodent ulcer* constitutes a large group of the malignant eyelid growths. Remarkable results from radiotherapy are reported in this class of lesions. *Lymphoma* of the eyelid have been treated by P. Boyer, Redslob, Speciale-Picciché' as well as by several Americans.

Sarcomata of the eyelids, while less frequent than *carcinomata* give good results with radium, according to Aikin, Broeman, Clapp, v. Hippel, Jendralski, Sattler, and many others.

(b) In the treatment of diseases of the lacrimal apparatus, radium acts well in chronic *dacryocystitis,* in *fistula* of the lacrimal sac, and *trachomatous infection* of the caniliculi and sac. *Tuberculous* lesions of the tear sac respond well to radium therapy. Kumer and Sallmann[6] give valuable data on the treatment of tuberculosis of the lacrimal apparatus as well as tuberculosis in other portions of the eye. *Mikulicz's disease* and *lymphadenomas* of the lacrimal glands give good response. This agent is useful in *papillomas* of the *caniliculus.* Radium is of great value in those *epitheliomata* which occur at the inner canthus of the eye and about the tear sac. Posey[7] cites a case of the tubular variety dispelled by its use.

Group II. Some Conditions of the Anterior Segment in Which Radium Has Been Found of Value

This group offers a wide variety of lesions amendable to radium therapy. (c) Nearly all forms of conjunctivitis accompanied by hyperplasia, papillary formation, and of a more or less chronic nature are greatly improved by irradiation plus the oral administration of oleum morrhuae. Secretions lessen, the conjunctiva becomes healthier and more normal in appearance. In early *trachoma* and vernal conjunctivitis, radium appears to be almost a specific at times. Castresana [8] reports the treatment of 100 cases of trachoma with satisfactory results. Lawson and Russ[9] think it will prove the best method of treating trachoma yet devised, that it will cure virulent cases without scarring and the other evils which follow trachoma, providing the radium is properly used. Müller and Högler[10] believe radium is a distinct advantage over methods used heretofore in the treatment of trachoma. Trachomatous *pannus* is much lessened and may entirely disappear under this form of therapy.

Tuberculosis of the conjunctiva is best treated with small doses of radium. The responses in tuberculous lesions of the eye is often wonderful. *Burns* of the conjunctiva heal more quickly if mild doses of radium are used. *Parinaud's conjunctivitis* as well as cases of obstinate *phlyctenular conjunctivitis* disappear. *Pterygium,* particularly the recurrent variety, can be successfully removed with repeated small exposures without damage to the eye. Some relief can be obtained in *pemphigus* of the eye.

Epibulbar tumors of the conjunctiva have been completely dispelled with radium alone. William H. Wilder[11] has reported several times concerning a case of melanotic epibulbar tumor which has gone over thirteen years without recurrence or metastasis, and has normal vision. Many reports of the successful treatment of epibulbar carcinomas with radium are found in the literature, the writer has failed to see a single case where surgery alone was used that did not develop recurrence within a year or two and it appears from experience that the treatment of such growths is best handled with radium.

Symmetrical lymphoma of the ocular conjunctiva as well as a case of papilloma, the latter with five recurrences, are reported. The papilloma was finally cured by the use of radium.

Of the *sarcomata* of the conjunctiva, the angio-sarcoma, the spindle and the giant cell types appear to be most favorably influenced by radium.

(d) Marvelous results with radium can be obtained in ulcers, leucomas, and opacities of the cornea. The writer has treated more than fifty ulcers of the cornea with but two failures. The hypopyon decreases, inflammation lessens, healing is more rapid, and scarring is much less than with any other method of treatment. I have seen a number of patients regain useful vision with opacities so extensive that the iris was invisible and only light perception remained, the patient having to be led about. Koster and others report cases of a similar nature. A case of vernal conjunctivitis of seventeen years' duration with extensive corneal scarring of one eye, and staphylo-

matous changes in the other with vision reduced to 20/200, after eight months' treatment with radium regained 20/70 vision with correction and the staphylomatous eye become more sightly. A veteran, gassed in France lost one eye at the time, and the other was left with only light perception because of a dense leucoma, came under my care in January, 1931. Now after seven months' treatment he sees the largest letter of the test chart at 27 inches, and goes about alone. It was impossible to distinguish the color of the iris when treatment was begun; now much of the iris and upper pupil margin is visible.

Recurrent types of *keratitis are* benefited. Three eyes with *keratoconus* have responded well, and show an improvement in the vision and less deformity. We believe the use of radium justified in this intractable disease. *Dermoid* tumors have been successfully treated with radium. I find radium very useful in *fistula* of the cornea, also in delayed healing after cataract extraction.

Reports of sixteen epitheliomas of the cornea are found, some of these were probably conjunctival in origin extending onto the cornea. The response to radium—in several cases permanent results—has been very satisfactory in corneal epitheliomas.

Review of the literature shows a few sarcomas of the cornea have been treated.

(e) *Scleritis* and *episcleritis* give good response to radium therapy. T. Collins (1916) reports its use in a melanotic sarcoma of the sclera.

(f) In *iritis* pain, plastic exudate and synechia are lessened by the use of small doses of radium. Scheerer,[12] Wassing, and others have found considerable help in *tuberculous* lesions of the iris. *Iridocyclitis* improves with mild irradiation. Much improvement in *sympathetic ophthalmia* is reported. Gonzales[13] reports a *leproma* of the iris cured by radium. Complete subsidence of a traumatic cyst of the iris has been reported. A few cases of tumors of the iris have been treated by irradiation alone. It appears that surgery combined with radium lessens the tendency to recurrence of iris tumors.

(g) The ciliary body being intimately connected with the iris responds to radium in much the same manner as does the iris, and a separate discussion is not necessary.

Group III. Lesions of the Posterior Segment in Which Radium is Useful

(h) The use of radium in cataract has already been discussed before this society, and will not be entered into here except to state that I have observed several cases of incipient cataract, the progress of which was stayed over a period of some eight years by its application.

(i) Several authors have noted improvement in hemorrhages into the vitreous. I have many times seen *opacities* of the vitreous lessened by radium therapy, and have used it cautiously in stubborn syphilitic cases accompanied by many floaters. I do not, however, advocate the general use of radium in specific lesions.

(j) *Progressive myopia* has improved with this agent. Several authors report *choroiditis* of tuberculous origin improved.

Deutschman (1915), Sattler [14] report on the use of radiotherapy in malignant carcinomatous growths of the eye. Radium has been used several times in *melanosarcomas* of the choroid of the only remaining eye in which useful vision was present. Some of these cases have been without recurrence for several years, and have preserved some vision after irradiation. The latest report is that of J. Foster Moore,[15] who used removable implants in a sarcoma of the choroid. There had been no recurrence in a year.

This is a remarkable report, as the radon was introduced directly into the melanosarcoma by making a small conjunctival flap over the site of the tumor. A minute incision, just large enough to introduce the seed was made in the sclera, and a 1 mc. threaded platinum seed inserted with a forcep. The flap was replaced over the seed and silk and allowed to remain for fourteen days. There was no serious irritation following the procedure. The process was repeated in two and one-half months using a 5 mc. implant and left ten days. The tumor shrank so that it was seen with difficulty, the vision was 3/60 with no decrease in the field. This report of J. Foster Moore's certainly gives food for thought in the treatment of accessible intro-ocular tumors.

(k) The retina also appears to offer some interesting and profitable results in the use of radium. Balbuena[16] reports on the treatment of a subretinal cysticercus. The cysticercus was killed and the eye saved.

Radium has proved of value in retinal detachment, particularly in those cases following war injuries, and in the detachment of high myopia.

A few cases of *retinitis, pigmentosa* have shown a little improvement.

Radium appears to offer some measure of hope in the treatment of *retinoblastoma.* A number of reports on the use of radium and roentgen ray in this type of tumor are found in the literature. Especially noteworthy are the reports of Axenfeld,[17] Jacoby,[18] and Benedict.[19] Axenfeld had several cases, one of which had gone five years without recurrence. Benedict used radium on the unoperated eye of a twin who had had one eye removed for glioma; the other twin died of glioma. In 1927 he reported this child still living and well at the end of five years. Radium to the extent of 90,000 milligram hours was given during this time. The child showed no ill effects except a beginning opacity of the lens. Schoenberg[20] reported a case in which one eye had been removed and a retinoblastoma appeared in the second eye; his patient remained well at the end of three years after treatment.

(l) Frasier, Bertolotti, Ferreri, Quick, Russy and others have shown that radium therapy offers improvement and restoration of vision in certain hypophyseal tumors which involve the optic nerve and chiasm.

(m) There are several conditions of the orbit in which I have found radium of advantage. In chronic inflammatory swellings or cellulitis without pus, such as occur occasionally in ethmoiditis and in partial thrombosis of the cavernous sinus and in the attendant inflammatory conditions arising from basal skull fractures, radium will help restore the normal contour of the orbit, and also preserve vision. Mention of its use in *tenonitis* is made.

Radium is of value in tumors which originate in the orbit itself. Bell and Touse[21] report an enormous, rapidly growing, inoperable tumor of the orbit, probably a sarcoma, which was successfully treated with radium; the elderly patient remaining free during more than two years of observation.

In vascular tumors of the orbit—*hemangioma* type—in children or adults the response is good. *Lymphangioma* of the orbit has been treated with radium quite successfully. *Carcinomata* at times appear to have been satisfactorily treated. The author's experience, however, is that they will recur in time. Gliomatous masses have been treated on several occasions; some authors observed their cases a number of years without any signs of recurrence or metastasis.

The largest number of orbital growths are sarcomatous in nature. Patients have survived as long as ten years after the treatment of a sarcoma with radium.

Group IV. Miscellaneous Affections Benefited by Radium

Temporary improvement in the swellings of *leukemia* may be had with radium, especially is this true of the orbital and conjunctival manifestations of this disease. Darier and other authors have shown the beneficial effect of radium in intractable orbital neuralgias, also in cases of recent facial paralysis. I have had occasion to verify these observations several times. The pain of *herpes zoster ophthalmicus* is much benefited by the use of mild doses of radium and the attack is often cut short.

Hypophyseal tumors have already been referred to. Tumors with acromegaly symptoms and sarcoma have shown improvement. In certain hyperplastic lesions of the sphenoid as well as in tumors of the same where the optic nerve tracts are involved and considerable neuralgic pain is present, radium is an invaluable help.

Very small doses of radium given over a period of several hours give prompt relief from the distressing photophobia and other ocular discomforts accompanying electric flashes in high voltage shocks.

Conclusions

Progress in the use of radium in ophthalmology has been slow but steady. Radium treatment is founded on a rational basis. The constant flow of energy from the element, its accuracy of measurement make it of real therapeutic value. The broken dose method has many advantages in ocular therapy. Biomicroscopy is most helpful in following up results of treatment. By its use scattered foci of malignant disease can be located which would otherwise escape detection.

The treatment may be long and tedious, frequent follow up work is necessary but the

results fully repay the time and skill necessary in using radium about the eye.

Discussion

Dr. A. F. Tyler (Omaha, Nebraska): I fully agree with the essayist's views and wish to commend her on account of the thoroughness with which she has reviewed the literature. I don't think there are any points that can be argued very much about. The Doctor has given us what are generally conceded to be the facts in the use of radium in opthalmology.

There is one question I should like to ask the Doctor. In describing a case I believe she said that 90,000 milligram hours of radium had been used during the treatment. There are different filters used in radium applications, and the different filters that are used to govern the type of radiation which comes to the patient. It occurs to me that if we did not cite in those cases the distances used and the amount of filter and its kind, someone who was not very much experienced in the use of radium, who might rent radium, we will say, as they do so much today, would use entirely the wrong technic. Ninety thousand milligram hours given at one time without filter will produce absolute tissue destruction, while 90,000 hours given with a 2 mm. filter and a 3 cc. distance, for example, would give an entirely different reaction. Or if the 90,000 milligram hours dose were distributed through several weeks or months of time we will still get a different reaction.

I should like to ask the Doctor to enlighten us on that dosage, if she will, please.

Dr. Ellis G. Linn (Des Moines, Iowa): The Doctor spoke of burns, conjunctival, particularly, and I should like to know whether or not that same line of care would be favorable to cornea burns, and whether she has had any experience with lime burns of the cornea, which of course are destructive to a greater depth than appears as a result from the first observation.

I should like to ask the Doctor what takes place in the treatment of synchiea. When the exudate is thrown down I should like to know the process that takes place in the absorption.

Dr. Laura A. Lane (Minneapolis, Minnesota) closing discussion: The case I cited in which 90,000 milligram hours of radium were used I think is a very good point for further exposition. That was a case under Dr. Benedict's care at the Mayo Clinic. I think it was four years ago that Dr. Benedict discussed a paper of mine that was read at the Dallas meeting of the American Medical Association on "The Use of Radium in Opthalmology." He got up and said we needn't be afraid of using radium around the eye because he had used 40,000 milligram hours of radium on this glioma case at that time and he had never had any unfavorable reaction. The child was doing well and still maintains quite a good deal of sight. He gave nothing as to the technic or the filtration.

About two or three years later (all of this is in my bibliography) he discussed the same case at one of the staff meetings, and it is published in the proceedings of the Mayo Clinic, in which he had then gotten up to 90,000 milligram hours of radium. These applications have been going on over a period, I think, of about five years. Dr. Benedict did not state in his last communication how the radium was used or anything about the technic of it, so I do not know that.

Of course, we have to be very careful. A little over a year ago, on an ocular tumor, undoubtedly a glioma, I have used as high as 1,000 milligram hours on the child. That tumor (I am watching it) has been reduced to where it is now only a little gray mass. The child's eye has become somewhat straighter. The child is growing and developing well. I have used in that patient, about 12,000 milligram hours altogether at various times. Only once have I obtained a reaction. I keep the radium quite a good distance, from 2 to 6 cc., and I use very heavy filtrations. I think that is the secret of any success I have had. I have always used very heavy filters. I use platinum screening material.

Of course, where it is a heavy external application we must use brass in addition. I do not use lead about the eye.

With reference to Dr. Linn's burns, of course the dose must be kept exceedingly mild. I often use only perhaps 75 to 100 milligram hours exposure and the amount of radium not over 10 or 15 milligrams or millicuries.

I sometimes use that with an extra platinum screen, with one mm. of platinum, with just a very, very thin filter, not over a quarter of a mm. deep. I pass it over the area that is burned.

I find that the pain is lessened very quickly, sometimes within one or two or three hours. The pain will practically cease, and we all know that burns at first are very painful. I have never seen it increase the sloughing of a cornea.

On lime burns, I have had only one patient. That was a healed case but with terrible disfigurement. That case had a very decided improvement following the irradiation. I got improvement in vision and a very decided lessening of the symptoms. The case had been operated several years before it was turned over to me for treatment. I saw that little girl this June and she has still maintained a very good result.

Of course, the effect there must be partially on the circulation and also on the nerve in the cornea.

Radium in small doses has a very soothing effect on neuralgic conditions and I think it helps increase the circulation of the lymph. It also brings new blood to the tissues, and if you do not produce too much hyperemia with it, it is quite beneficial. I have seen some very severe ulcers of the cornea that inside of 24 hours would look very much better. That dark, ugly look that we get where the tissue has been congested for any length of time will be cleared up very remarkably within 48 hours of the application of a little dosage of radium.

Radium has a good effect on synechia. That

has been observed by a number of people who have recorded the beneficial effect on cases of synechia. I have had several such cases and they dilate fairly well after using radium. I always use it with atropine.

Dr. L. L. Doane (Butler, Penna.): Have you used radium on glaucoma, either primary or secondary?

Dr. Laura A. Lane: I asked that question at one of the meetings of the American Medical Association. Personally, I do not believe that we are justified in using radium to any extent in glaucoma. Perhaps I have a little different idea of glaucoma from that of the average person. I think it is due to the difference between your osmotic pressure and your colloidal vessels on the one side with your capillaries changed to vitreous on the other. There is a disturbance in the equilibrium there and the change we get around that region is not the cause of the glaucoma *per se*. Dr. Corbett who is I think connected with the Boston City Hospital, has reported quite extensively on the use of radium in glaucoma. He experienced very favorable results.

I do not say that radium will lower tension temporarily, but from my experimental work on the eyes of rabbits (and I have done considerable experimental work with radium on rabbit eyes) I have seen tremendous increases of tension from the use of radium, particularly in large doses.

A rabbit carries a rather low tension, about 15 or so, and I have seen it rise up to 60 or 70 after a dose of 200 milligrams for half an hour, heavily screened, at 2 cc. distance. For that reason I am not favorable to the use of radium in glaucoma. I have seen one or two cases of iritis develop increase in tension and we had to stop using atropine. I don't think that was glaucoma *per se*.

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WILLIAM GILBERT, THE FATHER OF ELECTROTHERAPY *

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PHILADELPHIA

The famed physician, William Gilbert, whose painstaking researches have meant so much in the development of electrotherapy, was born in Colchester, in the Parish of Holy Trinity, Essex County, England, in the year 1540. According to Philip Morant,[1]—"Rector of St. Mary's, Colchester, and of Oldham near the same"—"This parish had the honor of giving birth to and also of being the seat and residence of the most learned Dr. William Gilberd." He qualifies this statement by the following quaint parenthetical explanation: "(so he writ his name; and not Gilbert, as it is generally written by others. His own house in this parish anciently called Lanseles, and Tymperley's or Tympernell's (Old Taxation) is the same that Sergeant Price, the late Recorder of this Borough lived in, and now belongs to Thomas Clamtree, Esq.)." Morant has added painstaking biographical detail to his work by delving deep into the family history of this man. He comments: "And here it will not be improper to give some account of that great man. He was the son of Hierom Gylberd, Gent, born at Clare, in Suffolk, admitted a Free-burgess of Colchester in 1553 and some time Recorder of the same. His great grandfather, Thomas Gilberd, born at Hinticlisham in Suffolk, was also made a Burgess of this Town in 1428."

Gilbert, then (or Gilberd, as you choose), came from a good family, with a high reputation in their own community. They were, apparently, of settled ways, and did not travel far from their ancestral home. Nothing of unusual character can be found concerning Gilbert's early life and education, which was seemingly tranquil and uneventful. We find that when he was a young man of eighteen years, he matriculated, at Easter, in the University of Cambridge. Morant[1] writes that he "studied in both our universities, afterwards he traveled into foreign countries; where probably he had the Degree of Doctor in Physic conferred upon him, for he doth not appear to have taken it either at Oxford or Cambridge." In regard to this Morant[1] was not fully informed; for the Alumni Cantabrigienses, University of Cambridge,[2] shows that Gilbert received not only his A.B., but his M.A. and M.D. degrees at Cambridge. The record reads as follows: "Gilbert, William. Matric. pens. from St. John's, Easter, 1558. S. of Jerome, recorder of Colchester. B. at Clare, Suffolk, 1540. B.A., 1560-1; M.A., 1564; M.D., 1569. Fellow, 1561." It will be noted that this record gives his birth place as Clare, Suffolk; however, Morant,[1] Williamson[3] and Hale-White[4] all state that he was born in Colchester, and it is certain that most of his early life must have been spent in Colchester.

Williamson writes[3] that "He became a student at St. John's College, Cambridge, and was afterwards elected Fellow of his College." The Dictionary of National Biography[5]) states that, "When twenty years of age he graduated B.A. at St. John's College, Cambridge, and was elected a fellow on 21 March, 1561." After receiving his M.D. degree at the age of twenty-nine, he became a "senior fellow of his college on 21 Dec., 1569." After having spent eleven years in scholarly pursuits at Cambridge, he apparently went abroad for further study. Both Hale-White[4] and Morant[1] state that he traveled abroad, but they give no details; and Williamson[3] states merely that "for four years he traveled in Italy." It is, nevertheless, probable that he continued his studies abroad, and thus completed the copious education so long pursued at St. John's, and which was to bear such remarkable fruit in the years to come.

On his return to England, the Dictionary of National Biography [5] states: "In 1573 he settled in practice in London and soon after became a fellow of the College of Physicians." Hale-White[4] states that, "He lived in Wingfield House, Peters Hill, which leads from St. Paul's Churchyard to Upper Thames Street." He was now a mature man of thirty-three years, and his fame as a physician evi-

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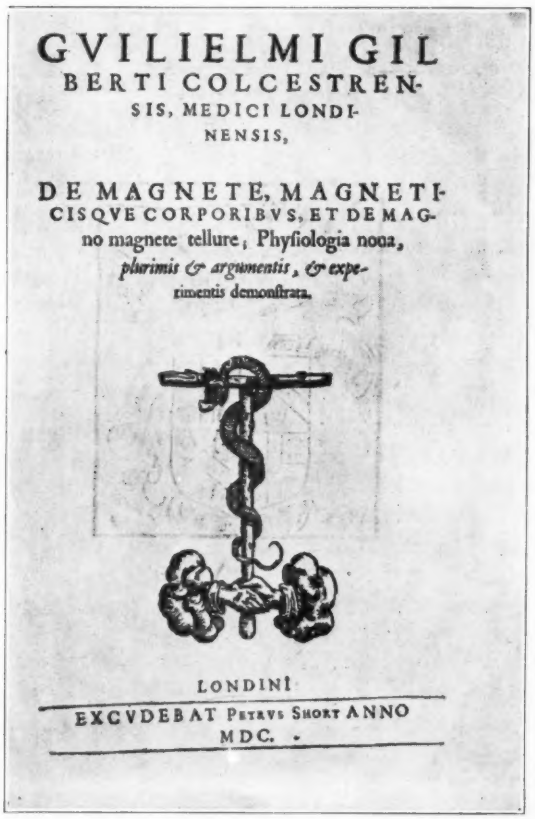
WILLIAM GILBERT
1540-1603
Father of Electrotherapy
1. Drawn for the author by Mr. Benton Spruance.

dently spread very rapidly. Hale-White[4] writes that, "He was well known outside his profession for he attended many celebrated people and was physician to Queen Elizabeth." Silvanus Thompson's[6] statement that his relations with English physicians were intimate and extensive must be correct, for Gilbert held several offices at The Royal College of Physicians. "He became Censor of the College in 1581 and was appointed to that office in seven subsequent years. He was treasurer of the College for 9 years and in 1600 was elected president." Morant[1] writes, "being famed for his learning, great knowledge in Philosophy, and admirable skill in Chemistry, he became . . . Chief Physician to Queen Elizabeth, who had so high a value for him that she allowed him an annual pension, to encourage him in his studies. He was also chief physician to King James I." Hale-White[4] states that, "the story that Queen Elizabeth left him a legacy shows her liking for him." He further states that Gilbert was "elected to advise the Privy Council about the health of the Navy."

Despite these multifarious duties and an apparently busy practice, Gilbert spent many hours during his years in London in the painstaking researches which were to bring him undying fame. After eighteen years of labor, he finally published his great book *De Magnete*. The year 1600 marks the height of Gilbert's fame. In this year, at the age of sixty, he was elected president of the College of Physicians; and in this year he published, in London, his epoch-making treatise on magnetism. The following year (in February, 1601), he was appointed "Chief Physician in personal attendance on Queen Elizabeth."

Williamson[3] states that "Gilbert was a man of means and spent money freely on his experiments, books, instruments, magnets, etc. For 20 years, he experimented and speculated on magnetism and frictional electricity." Hale-White[4] relates that "according to Harvey, Gilbert expended no lesser sum than five thousand pounds on his researches." It is probable that much of this money came from pensions from the Queen.

Let us see if we can reconstruct a picture


GVILIELMI GIL
BERTI COLCESTREN-
SIS, MEDICI LONDI-
NENSIS,

DE MAGNETE, MAGNETI-
CISQVE CORPORIBVS, ET DE MAG-
no magnete tellure; Physiologia noua,
plurimis & argumentis, & expe-
rimentis demonstrata.

LONDINI
EXCVDEBAT PETRVS SHORT ANNO
MDC.

2. Title page (reduced) of William Gilbert's Treatise on the Magnet (1600) from "The Evolution of Modern Medicine" by Sir William Osler — Yale University Press, New Haven, 1921.

of him at this time. We can probably see him at the work he loved best. A man "of stature tall and of cheerful countenance," with close-cropped beard and mustache, with determined mouth and alert eye, well dressed, for he was "a man of means," in the fashion of his time, with large, flowing sleeves, full breeches, brocaded waistcoat and the large, ungainly ruff of the Elizabethan era about his neck. He has probably returned from a busy day's practice. He has walked past St. Paul's Churchyard, and has entered his home, Wingfield House, on St. Peter's Hill. In order to work in comfort, let us hope that he has laid aside some of his cumbersome attire. He is now in his work room, surrounded by globes, magnets of all sizes and shapes, diverse minerals, precious gems; pieces of amber, wax and jet are lying on a table before him. Various instruments and books surround him as he bends over his work. He is comparing the attraction power of loadstone and rubbed amber. He carefully weighs both loadstones and pieces of amber. Next he weighs tiny bits of straw and larger pieces of steel. He then makes his experiments. Finally, he carefully records his results, which are about to appear in his famed opus.

The full title of his famous book was *De Magnete, Magnetisque Corboribus, et de Magnus Magnete Tellure, Physiologia Nova, Plurimus et Argumentis et Experimentis Demonstrata* (Of the Magnet, Magnetic Bodies, and of that Great Magnet the Earth, the New Physiology, Set Forth by Many Arguments and Experiments). The Dictionary of National Biography[5] records that "It was the first great physical book published in England." It continues, "His merit was immediately recognized both in England and on the Continent. Bacon mentions Gilbert with respect in the *Novum Organum.* The author had worked at his subject for many years, revising and experimenting. He begins by a summary of existing knowledge about the magnet, exactly resembling the commencement

of a modern scientific essay. The next part is characteristic of his own time, and is an account of the names of the loadstone and their etymology. The remainder is an investigation of the properties of the magnet illustrated by diagrams and relating numerous experiments. His general conclusion is that the phenomena of magnetism are explained by regarding the earth as one vast spherical magnet."

Williamson[3] writes: "Gilbert had a loadstone ground into a globular form, thus having the shape of the earth. This he named a 'terella,' or little earth. By placing magnetic needles on this 'terella,' he was able to make a large number of observations. These observations helped him to build up his theory of terrestrial magnetism. His book is devoted chiefly to magnetism, but in Chapter II he describes a large number of phenomena somewhat resembling those which are magnetic. He showed that by the friction of glass, wax, sulphur, and many other substances besides amber an attractive power could be produced. To this power he gave the name 'electricity' (electricitas) from the Greek name for amber (πλεκτρον). To Gilbert, therefore, we owe the word 'electricity.' In this marvelous book he laid the foundation of terrestrial magnetism and electrical science."

Hale-White[4] remarks that "Gilbert's outstanding position is due to this: he broke away from tradition, he challenged authority, he went to nature herself, investigating her by experiment, and he employed proper inductive reasoning. This book . . . is the earliest known work treating of both magnetism and electricity. It places Gilbert on a level with Harvey, Galileo, Gassendi and Descartes."

Garrison[7] writes of the *De Magnete* as follows: 'This work ranks beside Newton's *Principia* in that it threw overboard the Arabian Nights' supertitions attributing the deflection of the compass needle to 'magnetic mountains' or magnetic influences from the stars and the ancient sailors' belief that garlic destroys a magnet's power. Gilbert is also memorable for the discovery of frictional electricity to which he gave its name from the amber (πλεκτρον) employed."

Silvanus Thompson[6] says of Gilbert: "In an age given over to metaphysical obscurities and dogmatic sophistry, he cultivated the method of experiment and of reasoning from observation, with an insight and success which entitles him to be regarded as the father of the inductive method. That method often accredited to Bacon, Gilbert was practicing years before him."

While the greater portion of *De Magnete* is devoted to magnetism, nevertheless, a very important section, in Book II, deals at length with the subject in which we are especially interested — electricity. Thompson[8] credits Gilbert with no less than twenty separate discoveries concerning electricity. He writes: "Gilbert's experimental discoveries in electricity may be summarized as follows":

1. The generalization of the Class of Electrics.
2. The observation that damp weather hinders electrification.
3. The generalization that electrified bodies attract everything, including even metals, water and oil.
4. The invention of the non-magnetic *versorium* or electroscope.
5. The observation that merely warming amber does not electrify it.
6. The recognition of definite class of *non-electrics*.
7. The observation that certain electrics do not attract if roasted or burnt.
8. That certain electrics when softened by heat lose their power.
9. That the electric effluvia are stopped by the interposition of a sheet of paper or piece of linen, or by moist air blown from the mouth.
10. That glowing bodies such as live coal, brought near excited amber discharge its power.
11. That the heat of the sun, even when concentrated by a burning mirror, confers no vigor on the amber, but dissipates the effluvia.
12. that sulphur and shellac when aflame are not electric.
13. That polish is not essential for an electric.
14. That the electrics attract bodies themselves, not the intervening air.
15. That flame is not attracted.
16. That flame destroys the electrical effluvia.
17. That during South winds and in damp weather, glass and crystal, which collect moisture on their surface, are electrically more interfered with than amber, jet and sulphur, which do not so easily take up moisture on their surfaces.
18. That pure oil does not hinder production of electrification or exercise of attraction.
19. That smoke is electrically attracted unless too rare.
20. That the attraction by an electric is in a straight line toward it.

These observations indicate the painstaking care with which Gilbert studied the subject before him.

Certain quotations from his book[9] may be of interest. On page 6, under the heading "Interpretation of Certain Words," there appears for the first time the word "electric." Gilbert writes the following definition: "Electricks, things which attract in the same manmer as amber."

The following quotations indicate Gilbert's powers of careful reasoning. In Book II, he writes: "Fracastorio in the eighth chapter of his *De Sympathia,* says that a piece of iron is suspended in the air so that it can be moved neither up nor down if a loadstone be placed above which is able to draw the iron up just as much as the iron itself inclines downwards with equal force; for thus the iron would be supported in the air; which thing is absurd, because the force of a magnet is always the stronger the nearer it is. So that when a piece of iron is raised a very little from the earth by the force of the magnet, it needs must be drawn steadily on towards the magnet (if nothing else comes in the way) and cleave to it." In commenting on such false reasoning as that of Fracastorio, Gilbert remarks: "O that the gods would at length bring to a miserable end such fictitious, crazy, deformed labours, with which the minds of the studious are blinded."

In Book I, Chapter XV, he discusses "The Medicinal Virtue of Iron" in part as follows: "It is given chiefly in cases of laxity and overhumidity of the liver, in enlargement of the spleen, after the evacuations, for which reason it restores young girls when pallid, sickly and lacking colour to health and beauty." He gives a splendid description of the therapeutics of iron, which could be little improved upon today.

In Book II, Chapter II, he discusses the action of "Electricks"—a chapter which is summarized by Silvanus Thompson[8] and cited above. A few direct quotations may prove interesting. "Amber truly does not allure by heat, since if warmed by fire and brought near straws, it does not attract them, whether it be tepid, or hot, or glowing, or even when forced into the flame. Amber in a fairly large mass allures, if it is polished; in a smaller mass or less pure it seems not to attract without friction. But very many electricks (as precious stones and some other substances) do not attract at all unless rubbed. On the other hand many gems as well as other bodies, are polished, yet do not allure, and by no amount of friction are they aroused. Metals, marbles, flints, woods, herbs, flesh and very many other things can neither allure nor solicit any body either magnetically or electrically. (For it pleases us to call that an electrick force which hath its origin from the humour.) A loadstone raises great weights; so that if there is a loadstone weighing two ounces and strong, it attracts half an ounce or a whole ounce. An electrical substance only attracts very small weights; as for instance a piece of amber of three ounces weight, when rubbed, scarce raises a fourth part of a grain of barley. The difference between Magneticks and Electricks is that all magneticks run together with mutual forces; electricks only allure."

After reading *De Magnete,* Galileo wrote, "I extremely praise, admire and envy this author for that a conception so stupendous should have come into his mind. I think him moreover worthy of extraordinary applause for the many new and true observations he has made."[4]

After publishing his monumental work, Gilbert did not live long to enjoy the honors that were showered upon him by his fellow scientists.

As "chief physician" to Queen Elizabeth, he was probably one of the group of "ten or twelve physicians that were continually about her"[3] when, overcome with remorse over the execution of the Earl of Essex, she developed mental symptoms, and lay upon cushions on the floor for four days. Despite her physician's entreaties, she refused all food and medicine, and finally succumbed.

Eight months later, Gilbert, who had in the meantime been appointed physician to King James I, followed his Queen in death. He was sixty-three years old when he died, on November 30, 1603.

Thompson[6] has given us an interesting letter, written by Gilbert during the latter part of his life. He describes the incident as follows: "On February 13 (1601) Gilbert wrote to Barlowe: 'I purpose to adioyne an appendix of six or eight sheets of paper to my book after a while, I am in hand with it of some new inuentions, and I would have some of your experiments in your name and inuention put into it, if you please, that you may be knowen for an augmenter of that arte.' This he never did. Perhaps his appointment (in

February, 1601) as chief physician in personal attendance on the Queen interfered with the project; or his death of the plague, in 1603, intervened before his intention had been carried into effect."

So passed one of the great scientists and physicians of all time.

The Dictionary of National Biography[5] states that "Some of his other scientific papers were printed at Amsterdam in 1651, after his death, edited by his brother (under the title *De Mundo Nostri Sublunari Philosophia Nova*), (New Philosophies of Our Sublunary World). He was unmarried and bequeathed all his books, globes, instruments, and a cabinet of minerals to the College of Physicians. They perished in the great fire of London in 1666. He was buried at Colchester, in the Holy Trinity Church, where his monument and epitaph, erected by his brothers Ambrose and William (of the same name as himself) still remains. It is a panel surrounded by a frame of Jacobean pattern surmounted by pinnacles bearing globes and fourteen shields of armorial achievements. His portrait, by Harding, once hung in the schools at Oxford and has been engraved by Clamp."

In describing Gilbert's achievements, Morant[1] writes: "He likewise invented two most ingenious and necessary Instruments for Seamen to find out the Latitude of any place without the help of Sun, Moon and Stars, made public by Theo. Blondeville at London, 1602. . . . His picture is in the schools gallery at Oxford which shows him to have been of stature tall, and of cheerful countenance."

Williamson[3] writes: "In the Town Hall of Colchester is an interesting painting by Mr. Acland Hunt. The subject was suggested to the artist by Sir Benjamin Ward Richardson. The painting represents Dr. William Gilbert exhibiting his electrical and magnetic experiments to Queen Elizabeth and her court (including Sir Walter Raleigh, Sir Francis Drake and Cecil Lord Burghley). This picture was presented to the Corporation of Colchester by the Institution of Electrical Engineers in 1903 on the 300th anniversary of Gilbert's death.

"On the façade of the Colchester Town Hall are four statues, one of which represents William Gilbert. A copy of his portrait may also be seen in the Colchester Public Library at the Town Hall."

Proof of the greatness of Gilbert's work can be found in the words of praise, concerning him and his great book, which are gathered from many sources.

Allibone's Dictionary of Authors,[10] in discussing his work on the Loadstone, gives the following quotations: "Dr. Gilbert hath written in Latine a large and learned discourse of the properties of this stone."—(*Dr. Hakewill's Apologie of the Power and Providence of God.*)

"A painful and experimental work."—(*Lord Bacon's Advancement of Learning.*)

"An admirable searcher into the nature of Loadstone."—(*Sir Kenelm Digby's Treatise of Bodies.*)

"Famed for his learning depth in philosophy and admirable skill in chymistry."—(*Athen. Oxon.*)

In addition to these, he has been referred to by C. W. Cooke as "The first electrician";[4] by Williamson[3] as "one of the most distinguished scientific men of his age"; by Sir William Osler[11] as the "author of the first scientific book published in England." Sir Kenelm Digby, in referring to Gilbert, states: "By means of whom our nation may claim as deserved a crown for solid philosophical learning."[4] Hale-White[4] calls him "one of the great original geniuses among the great Elizabethans." Thompson[12] says that, "He made notable contributions to astronomy, being the earliest English expounder of Copernicus."

He has been named the father of three different fields of learning. Hale-White[4] terms him: "The father of experimental philosophy." Silvanus Thompson[12] calls him: "The father of the Inductive Method of reasoning"; as well as, "The father of Electric Science."

To this, I should like to add the term "The father of Electrotherapy."

While it is true that there is no record that he ever applied his knowledge of electricity to the treatment of disease, there is also no record that he ever made practical use of any of his electrical experiments. He was, however, the experimenter who laid the foundation stones of modern electrotherapy. The earliest use of electricity, which was almost entirely for the treatment of disease, was based on the experiments ofthis great physician, who gave us the name "electricity." All physicians who are interested in electrother-

apy should be proud that this famed colleague gave us this word.

Of him, Dryden eloquently sings:

"Gilbert shall live till loadstones cease to draw
Or British fleets the boundless ocean awe."[11]

With such worthy and fluent praise from so many great men before us, any words of eulogy that we might add would seem an anti-climax. We may, however, with fitting pride, assert that William Gilbert was the father of *our* branch of medicine.

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Physiologist Appraises Dr. Warburg's Work

A scientist's estimate of the achievements of Dr. Otto Warburg in recognition of which he has been chosen for the Nobel Prize in medicine and physiology for 1931 are contained in a statement made to Science Service by Dr. W. H. Howell, chairman of the Division of Medical Science of the National Research Council. Dr. Howell was for many years director of the School of Hygiene and Public Health of the Johns Hopkins University, Baltimore. He said:

"The selection of Prof. Otto Warburg for the Nobel Prize in medicine and physiology for 1931 will be cordially approved by American physiologists. He is well known and esteemed in this country for his fine work upon cell metabolism.

"His investigations upon the respiration or mechanism of oxidation in the living cell are of fundamental importance. He has shown that the cell depends upon the ion contained in it to utilize the oxygen that is brought to it by the blood. The ion exists in the cell in a special form, an iron porphyrin compound, which is present in very minute concentration, perhaps one part to a million, but it is very active and functions as a catalyst or ferment which takes up the oxygen and then gives it to oxidizable substances within the cell. In such small amounts its nature could not be detected by ordinary chemical means and Prof. Warburg devised a delicate spectrographic method depending upon the absorption bands given by its compound with carbon monoxide.

"Another significant contribution was his study of the metabolism of the cancer cell as compared with the normal cell. He was able to show that malignant growths have a small respiration but contain relatively large amounts of lactic acid. His work figures largely in all discussions upon the cause of cancer."—(*Science News Letter, November 7*, 1931).

PROTECTION AGAINST RADIO INTERFERENCE FROM ELECTRICAL APPARATUS *

RICHARD KOVACS, M.D.

NEW YORK

Installation of radio apparatus in homes has become universal and the uninterrupted enjoyment of jazz waves, political harangue, sales talk, together with other really useful information, is being considered essential for the pursuit of happiness of the average American citizen. Every physician operating a high frequency, x-ray or static machine is undoubtedly often reminded by his neighbors of its disturbing influence on radio reception, and in some localities there are definite ordinances forbidding the operation of such apparatus in the evening hours.

In moving his offices into a new eighteen story steel and concrete apartment building, the write was confronted with a request from the landlord for the protection of radio sets in the house. By mutual agreement shielding devices were installed which have given effective protection during the past year.

After consulting experts, two lines of protection were considered advisable: (1) full shielding from leakage waves set up through the air and walls by the electrical apparatus; (2) protection against back surging of high frequency or other currents through the house wiring.

The protection against interference through the air was accomplished in the construction stage of the building by metallic shielding of all rooms in which apparatus was to be housed and by grounding the metal sheath in an approved manner. Fine wire mesh (metal lath) was used to cover all walls in their entirety before they were plastered over. The same metal lath was placed under the flooring. The ceiling being of metal lath construction, no extra wire mesh had to be suspended. The metal lath of the ceiling, of the side walls and of the floor were all electrically connected by a network of fine copper wiring (No. 12), laid out to form squares of about one foot square and soldered to the wire mesh. Metal doors and frames were installed throughout and the copper wiring was also soldered on to these and then grounded.

As the building was unfinished, these arrangements could be made with comparative ease, although the material and cost of labor (Union work) amounted to nearly $300 for the space of 20 by 28 feet square and nine feet high. It is likely that in a finished building a similar shielding could be effected by covering the walls with beaver board coated on the side walls with tinfoil and forming a panel effect.

It was planned to install a leakage condenser and inductance between the line connection to the apparatus and ground for the purpose of preventing any surge of high frequency from passing back through the house wiring, thus causing possible interference. While waiting for the installation of this device, tests were made with a radio set in the apartment and outside of it, and it was found that the protection provided by the shielding of the room was sufficient. Four high frequency machines and one static apparatus were kept in operation simultaneously and there was no interference in the radio immediately above the machinery in the duplex apartment of the writer. For this reason it was considered unnecessary to install any additional protecting device. No complaint about interference of any sort was received during the year.

It is my privilege to thank the technical department of the Westinghouse X-Ray Company for their aid in solving this problem.

1100 Park Avenue.

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ARCHIVES of PHYSICAL THERAPY, X-RAY, RADIUM

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Editor: DISRAELI KOBAK, M.D., CHICAGO

E D I T O R I A L S

The Editor, the Editorial Board and the Officers of the Congress extend

Season's Greetings

and sincerely wish the fellows of the Congress and the subscribers to the Archives

A Merry Christmas

and a

Very Happy New Year

ADVANCES IN RADIATION AND RADIATION THERAPY

Although no one can fully predict the far-reaching significance (or perhaps the limitations) of some of the recent contributions in the field of physical sciences, a few undoubtedly bear the stamp of sufficient durability and permanency to suggest new stepping stones for medical progress. For example, it is now difficult to point to any particular section of the electromagnetic spectrum that in the past several years has not had the benefit of additional study and interpretation. From this there has developed sharper refinement in apparatus and further indications for the clinical and industrial application of various agents to the field of medicine and commerce.

In the field of radium, its prohibitive cost has led to the invention of a new process in refining this rare element. Chemists at the University of Missouri under the supervision of Dr. Herman Schlundt, have started the operation of the only known laboratory in the United States for refining radium and mesothorium from the paint off luminous dials of old watches and clocks. Thousands of dollars of these precious elements have already been recovered and it is predicted that more of it will be so accumulated. The old truism of necessity being the mother of invention is nowhere more fittingly illustrated as in times when our therapeutic facilities begin to show appreciative signs of depression, or when we consistently encounter unexpected *cul-de-sacs.*

Only a few years ago, through the columns of the *Jour. A. M. A.,* the medical profession was apprized of a serious situation that was affecting the workers in radium industries, particularly painters of watch dials. Simultaneously with the news of deaths resulting from the poisoning of unfortunate factory workers in this industry, announcement was made of a promising method of treating this condition by means of irradiated sterols. Finn, of Columbia University, was able to demonstrate detoxification properties in irradiated material of specific benefit to those suffering from radium poisoning. The scope of this practical research may now be logically extended to include all such cases as have been subjected to intensive radium influences. Gynecologists in particular have for a long time been aware of the serious sequellae known to follow from radium treatment. The end-results have often been as bad as the cure itself. And because of our impotency to correct this situation, many leading surgeons have in the past chosen the risk of surgical intervention, rather than the risk of disasterous invalidism as a result of radium application. According to Finn, viosterol, or the natural product, ultraviolet light, plays an important defensive role in radium intoxication by increasing the calcium and phosphorus content of the blood—even to a greater extent than parathyroid or other compounds. Thus a new avenue for the scientific exploitation of ultraviolet is opened to the profession in situations following massive radium therapy.

The medicinal qualities of radium injection and emanation baths have long been regarded with suspicion and looked upon as a borderline type of therapy—dangerous or useless for medicinal purposes. For a long time radium salts have been utilized by *kur-pfuschers* (quacks) and *kur-orte* under the claim of possessing certain beneficial, provocative effects on metabolic process' but only recently has conservative medicine in America placed the stamp of a modicum of recognition on its merits as an adjuvant in therapeutics. In the light of previous critical comments published in the *Jour. A. M. A.,* it is gratifying to note the editorial tolerance of this organ, exemplified by the following comment on radium medication, section on *Foreign Letters,* (June 6), 1931:

> "Radon, or the emanation of radium, has certain therapeutic applications concerning which Professor Rathery and M. Molinéry have made a careful study, the results of which they presented recently before the Academy of Sciences. It produces interesting modifications of the general metabolism and, in particular, lowers the development of uric acid. Its effects are very marked in chronic rheumatism and gout, which supports the belief that it causes a stimulation of certain functions of the liver. This would explain, they think, the effects of thermal springs in these pathologic states—effects that have been known empirically for many centuries and that may be associated with radio-active emanations. The same effect has been secured, away from the springs, by inhalations of radon."

It is the conviction of foremost students of the subject that the future development of radium therapy is in the direction of its recognition as a medicinal agent *par excellence.* It is predicted that the indications will be broadly extended and will include many affections other than that of rheumatism and gout. Indeed, as a foreshadow of this coming era, it has been found that even certain

forms of psychopathies are now benefited from the administration of mild injections of this rare element. It becomes obvious that more concerted research must be initiated regarding the physico-chemical influences of small doses of radon and the radium salts on biologic structure. Fundamental information in this direction is needed in order to better understand its possibilities and its limitations.

ADVANCES IN ROENTGEN RADIATION

Man's restless search for knowledge has materially reduced the boundaries of the unknowable both in the interstellar and the interatomic fields of phenomena. The vast spaces in both directions have been diligently analyzed in the crucible of intensive laboratory investigation. Refinement in equipment and greater orientation in the respective subjects under investigation have resulted in many practical and academic contributions to the field of industry, science and radiology. The titanic forces inherent in the rays of infinitely small proportion are now more firmly harnessed to the cause of human endeavor than ever before in the history of civilization. Lawrence and Edelfsen, University of Califoria, have devised a method for increasing the speed and energy of the *protons* or the heart of hydrogen atoms so that it may be possible when the method is farther perfected to use them as atomic projectiles for smashing the hearts of other atoms, thus foreshadowing an era when the transmutation of substances and the release of enormous quantities of atomic energy will be made possible. Workers at the California Institute of Technology have also produced an apparatus containing a giant vacuum tube operating at 700,000 volts, which creates artificial *gamma* rays in extraordinary abundance. This promises to replace the use of radium in the treatment of cancer and to augment the results heretofore obtained by this substance.

A new departure in the transmission mechanism of x-radiation has recently been suggested by Reboul, of the Physics Laboratory, Montpellier, France, which promises additional refinement in application. It is a method that at first reading emphasizes its novelty rather than its practicality because it does not require the use of x-ray tubes. The rays are produced when electric currents are drawn through solids of high electrical resistance with the help of high electrical pressure. By this method only x-rays of low penetration are produced. It is not at all unlikely that rays of such limited penetration may in the near future be manufactured in sufficient quantity to enhance the effects produced by soft rays (Grentz rays), described by Bucky, Eller and McKee, and perhaps that of the shortest ultraviolet rays.

"Scientific investigators," comments the *Industrial Bulletin*, "are now permitted to study substances whose structures had previously been a mere matter of speculation and guess work. Characteristics and arrangement of these ultra-minute units may now be determined with comparative facility by means of the x-ray. This type of work, commonly known as x-ray diffraction study, should not be confused with the radiographic procedure which is used to differentiate between materials of different densities. . . . X-ray diffraction methods have reached the joint of development where they assume commercial and practical value, providing the research chemist or engineer with a new means of observing structure and arrangement in practically any molecular system. Not only is it possible to determine the normal structure in a given substance, but the x-ray assists in bringing about a rearrangement of the natural structure to impart to any given substance new properties which may prove desirable. Industrially the application of x-ray diffraction study is in its infancy, but, due to its remarkable potentialities, promises to become an important factor in future scientific development."

The x-ray in industry has come to be considered by many as more important than its use in medicine. The x-ray is discovering hitherto unknown qualities or properties of scores of industrial materials in order to utilize them more efficiently. Studies of commercial commodities like rubber, for example, have revealed valuable phenomena concerning its behavior during stretching and after composition changes. Metallic alloys, fabrics, electric transformer plates, asbestos, corrosion in iron, paper, petroleum, products, and some organic chemical substances are among the materials studied. The use of the x-ray is opening a new field in industry by aiding the production of more standardized materials, the utilization of hitherto neglected substan-

ces, and improvements in the quality and efficiency of manufactured articles in every-day use. Great industrial concerns are realizing the value of the x-ray in solving their problems and now look to science for the extension and development of the work.

The future, no doubt, holds many problems for x-ray investigations. Many investigators in the past have been penalized for their discoveries by a martyrdom to excruciating suffering and release by death. In spite of this the contributions in the field of radiology has grown in luster and increased with time. Upon the basis of what has already been accomplished it may be predicted that through this means many biologic substances will have their desirable properties accentuated and their undesirable ones eliminated.

ADVANCES IN HIGH FREQUENCY THERAPY

Future generations of practitioners will no doubt regard present-day interpretations of the healing powers of high frequency current and its method of conversion into heat with the same attitude of tolerant amusement as the profession now regards, for example, the antiquated mysticisms in vogue during the supremacy of Galenic teachings. Unappreciated by most of us the therapeutics by means of high frequency current has gradually but definitely emerged from its sophormoric period and has entered into a new era whose scope will be far-reaching in importance. There exists today a better understanding of the physiologic possibilities of heat therapy on account of discoveries in the field or radiation physics which have furnished new and perhaps superior methods in creating and localizing heat within the body.

Ultra- or superhigh frequency current, has been critically investigated on a large variety of material at different times during the past decade. Studies of its specific effect on malignant rat tumors surrounded its early investigation with the halo of a possible cure for cancer. The illegitimacy of this speculation was soon demonstrated as was also the confirmation that currents of ultra-high frequency definitely provoked deep heating effects, the intensity of which could be so regulated as to produce healing or lethal effects in living tissue. Since then the problem has enlisted a wider range of brilliant investigators both in America and abroad, all of whom have contributed an important moiety to its elucidation. Not the least in value have been the recent contributions by Whitney, Carpenter, Knudsen, Bell and Ferguson regarding its physical and physico-chemical aspects, and King, Neyman, and their co-workers, regarding its clinical effect. From the conclusions of all these reports it has been established beyond preadventure of doubt that fever therapy as produced by high and ultra-high frequency current definitely provokes favorable effects in certain chronicities, associated with or without allergic phenomena, as also in general paralysis of insane, encephaloid state and so forth. The "and so forth" is purposely appended to the last sentence because it is now known that many other intractable conditions are now under investigation by means of artificial fever therapy and is already, even at this early period, giving promise of favorable results.

That production of fever by high-frequency current is a superior method to that of infecting the patient with malaria or other organisms, has been pointed out by the majority of workers on this problem. The facts that the treatment is under constant control of the operator and that there is no residual infection to contend with, are practical points in favor of the method.

The information that artificial fever can be generated by high-frequency current does not stir our enthusiasm as much as does the fact that it has opened up a new approach toward the alleviation of many affections now regarded as hopeless. It has furthermore given the medical profession a new orientation in connection with the management of certain forms of dementias which may be the starting point for a more vigorous offensive in the treatment of the insane. Undoubtedly, fever therapy has been the outstanding contribution in high-frequency practice.

Oscar Boto Schellberg, 51, inventor of devices used in colonic therapeutics, died of pneumonia at Bedford Village. He was born in Russells, Wis., and was a Spanish-American war veteran.

CURRENT NEWS AND COMMENT

Oscar Boto Schellberg — 1880-1931

News of the death of Oscar Boto Schellberg has been received with a feeling of deep depression at the untimely passing of one who, in spite of not possessing medical degrees, has been responsible in contributing a new therapeutic approach toward the alleviation of symptoms associated with chronic affections. Schellberg was a remarkable man in many respects. He was a paradox to those who did not know him intimately. A gruff and what apparently appeared to be an irascible exterior covered or rather shielded the most lovable, poetic, artistic and generous qualities that ever was given to any single man. He was keenly intellectual and highly artistic. His personality was rounded out by practical talents more widely appreciated than the rarer qualities mentioned above because it took form in tangible contributions now adopted by thousands of practitioners all over the world.

Schellberg's apparatus and technic of colonic investigation is today recognized as the most practical method yet contributed to the subject. Three decades of persistent investigation and dignified exploitation finally won him the recognition that he so avidly sought for the method. Unfortunately, the success of his method developed unscrupulous imitators. This and an acute sensitivity to criticism, greatly embittered him in recent years and, no doubt, had much to do with his untimely passing. The writer was fortunate in enjoying real intimacy with this man and thus knowing the splendid and rare qualities of his character.

Deep condolence is offered to his family as we pay sorrowful homage to his memory.

Roy Fouts Convalescing

We are pleased to inform the many friends of Dr. Fouts that our ex-President, in spite of severe contusions, lacerations and fracture of ribs is making an uneventful recovery. We are informed by hospital authorities that our distinguished patient is manifesting alarming symptoms of suppressed energy and mental vigor difficult to control. On account of this, drastic measures have been resorted to in order to prevent said patient from assuming the multiplicity of duties and responsibilities associated with his large practice. From this it is readily seen that Dr. Fouts' depression is merely physical (limited to two ribs) rather than monetary. We wish him speedy recovery.

Frank Walke

News from Shreveport, Louisiana, informs us that our former President, Col. Frank Walke, of surgical fame and master of jovial stories is recovering from his severe illness. He is wintering in a nearby sanitarium where they are catering to his sweet personality. His absence from the recent meeting in Omaha was distinctly felt by all those that were acquainted with him. We sincerely wish him God-Speed in his recovery and extend to him the heartiest season's greetings.

Cancer Only One of Nobel Prizeman's Research Lines

Cancer, biological physics, and the respiratory function of the tissues are the three chief subjects of research by Prof. Otto Warburg of the Kaiser Wilhelm Institute for Biology, Berlin, who has just been awarded the Nobel Prize in medicine for 1931. Prof. Warburg has made very important contributions in all three of these fields.

Most attention has probably been attracted by his work on cancer.

He showed that cancer cells have quite a different metabolism from ordinary tissue cells. They can get all the energy they need to live and grow and reproduce from the breaking down of sugar. Unlike other cells, they do not need oxygen but can live without it, much as some disease germs do. This does not mean that cancer is caused by germs, however. It is the suffocation of normal cells by lack of oxygen that gives the cancer cells a considerable advantage in the competition of growth, according to Prof. Warburg's views on the subject.

Prof. Warburg also investigated the photochemistry of plant cells, that mysterious process by which the cells turn carbon dioxide

and water into food in the presence of light. He measured very exactly the light absorbed by these green cells and compared it with the amount of carbon dioxide they used. He was then able to show a certain quantum relation between the two. This research of Prof. Warburg's was one of the first pieces of work in which biological physics was compared with the quantum theory.

Other work of Prof. Warburg's was in the field of cell metabolism. He demonstrated the constitution and action of the ferment in the tissue cells which controls the conveyance of the oxygen of the air from the lungs to the muscles and other tissues of the body.—(*Science News Letter,* November 7, 1931.)

Bendien Cancer Test Called Unreliable

The Bendien test for cancer is still being investigated by leading British laboratories in the hope that a reliable method of early diagnosis may be available to the medical profession, although Sir C. Gordon Watson, chairman of the Investigation Committee of the British Empire Cancer Campaign, has just poured cold water on these hopes. The proposed test was devised by Dr. S. G. T. Bendien of Zeist, Holland. It is not at present being applied clinically and the scientists working on it stress particularly the fact that it is not in any sense a cure or a treatment of cancer.

Sir Gordon Watson's opinion is that "although the preliminary results were encouraging, subsequent inquiries have failed to justify the early promise, and Bendien's method of diagnosis for malignant disease cannot at the present time be accepted as reliable."

Dr. Bendien's test consists of two parts, one chemical and the other spectroscopic. In the chemical test twenty tubes containing equal amounts of serum are treated with sodium vanadate in acetic acid solution of varying strength and hydrogen ion concentration, and the turbidity or flocculation produced is carefully noted. With normal serum the flocculation begins in the sixth tube. With serum from patients suffering from cancer, tuberculosis and one or two other diseases, flocculation takes place in earlier tubes. To distinguish between those ailments, Dr. Bendien dissolves the precipitate from the chemical test in a two per cent sodium bicarbonate solution and measures, by means of a spectrograph, its power to absorb ultraviolet light. This "absorption spectrum" is stated to differ according to the type of ailment, and Dr. Bendien claims that he can in this way distinguish cancer from the other diseases which behave in the same manner towards the chemical test. —*Science News Letter,* November 28, 1931.

New Radium Find in Canada May Break Belgian Monopoly

That radium to the value of several millions of dollars, just discovered in Canada, will break the Belgian world monopoly of this precious substance and speed up the relief of cancer victims is the opinion of competent mining experts in Washington.

The pitchblende treasure bearing $7,000 worth of radium in every ton of ore, discovered by Gilbert LaBine and Shirley R. Cragg, airplane prospectors, of the El Dorado Mines Corporation at Labine Point in the Great Bear Lake region, is equal in richness to the best ores of the Belgian Congo, which since 1922 have driven all competitors, including the United States, from the market.

The new ore is here described by geologists as "a very substantial deposit of high grade material" yielding one three-hundredths of an ounce of radium per ton. Twenty tons have already been shipped on a fur steamer of the Mackenzie river and forty more tons mined ready for shipment at a cost which compares favorably with Belgain freight charges on the long passage from Africa to the refineries in Europe.

Hundred-pound lumps were actually picked up on the surface. The radium from these will yield $70,000 a gram whereas the most valuable emeralds fetch only 5,000 a gram. Silver ore yielding $300 a ton has been found alongside.

The Canadian discovery, consisting apparently of several thousand tons of ore, will add greatly to the world's present 600 gram total supply of radium. Treatment of cancer, until now hindered by the prohibitive prices, will be helped.—*Science News Letter,* November 14, 1931.

THE STUDENT'S LIBRARY

DIATHERMY IN GENERAL PRACTICE. By *Erik Payten Dark,* M.C., M.B., Ch.M. (Syd.). WITH A CHAPTER ON DIATHERMY IN GYNECOLOGY WITH SPECIAL REFERENCE TO MAJOR SURGERY, by *F. A. Maguire,* D.S.O., V.D., M.D., Ch.M. (Syd.), F.R.C.S., (Edin.), F.C.S.A., AND A FOREWORD by *R. Scot Skirving,* M.B., Ch.M. (Edin.). Pp. 171 with 15 illustrations. Cloth. Australia: Angus & Robertson, Limited.

Who are the "many observers" who "have *conclusively* (Italics ours—Ed.) demonstrated that the greatest conversion of electrical energy into heat takes place between frequencies of 500,000 and 900,000"? On what *authority* (Italics ours—Ed.) is the statement made that "the optimum frequency changes with the resistance of the part to be treated"? Once again, where is the authority for the assertion, "If the best results are to be obtained in each case, a frequency most suitable to the part should be employed"? The foregoing quoted excerpts have been taken from the author's third chapter called *Fundamentals,* a chapter that is representative of questionable and unnamed authorities — misconceptions and exploded exploitations which have already been discarded by the very sources that first emanated them. As in this, so also have the author's sources of information been deflected by a novitiate's overenthusiasm, exemplified in the first chapter, *History,* wherein statements have been made that cannot be substantiated by facts and no doubt introduced under the influence of poorly selected source references. For example, it is astonishing to read the name of Morton as the man who first contributed to our knowledge of high-frequency current. Not even in America, the home of Morton, has any recognized student of the subject raised the question of suggesting that the honor of this discovery belonged to anyone else but d'Arsonval (an octagenarian and the late Snow excepted).

Hertzs' contribution in the field of pure electromagnetic phenomena has been acclaimed by the world of science as one of the outstanding original contributions of the nineteenth century. Its nearest inspiration is to that of Clerk Maxwell's contribution in the field of mathematics which it confirmed. Every discovery, like the light it sheds, invariably carries its shadows in the form of similar claims made by other workers. In regard to d'Arsonval's and Hertzs' contributions, the suggestion that it was inspired directly from Morton's work is met by the demand of proof from authoritative sources. Such we do know does not exist. Insinuations of such a nature have usually come from garrulous sentimentalists and have no foundation in fact.

There is much in this work that indicates hasty and uncritical reading, questionable technic and enthusiasm that has obtained for the author some very striking clinical results. It is fortunate that diathermy in spite of the general misunderstanding of its principles often has produced extraordinary beneficial effects. This is evidenced by the history of its progress, the new and old theories that have hindered and advanced its uniform adoption by the medical profession — facts which indicate that its real nature is still a mystery in need of unraveling. It is, therefore, not surprising that the author has experienced many striking results attributed to its direct penetrating action. For example, in spite of a technic which is directly opposite to that taught by teachers of the subject and does not follow the physical laws of electricity, the author advocates and illustrates diathermy of the wrist-joint by placing the palmar surface of the hand on a flat electrode and binding a cuff electrode approximately three or four inches above the wrist, (see illustration facing p. 64). If this illustrates diathermy through the wrist, then the law of "lines of least resistance and through shortest paths" has no place in the teachings of electro-physiology.

What has been said above is in the nature of constructive criticism extended by one student of the subject to another. In line of commendation it should be pointed out that in general the author has advanced diathermotherapy by his critical attempt at interpreting its effect and the introduction of valuable clinical data.

Scot Skirving in his foreword to this work well summarizes our own impression by the remark: "I can only say that this short book, written no doubt, as I have said by a keen enthusiast, is so full of reason and moderation that it carries conviction that the virtues of diathermy should be better known and more widely used than they are at present by the members of our profession."

HYPERTENSION. By *Leslie T. Gager,* Clinical Professor of Medicine, George Washington University. Pp. 158. Cloth, price $3.00. Baltimore: The William and Wilkins Company, 1930.

The importance of the study and treatment of vascular disease has been duly emphasized in the past several years because of our greater appreciation of its morbid implications as judged by statistical tables on mortality. The author of this praiseworthy contribution has incorporated a great deal of pertinent data based on functional pathology as a starting point for his exposition of the clinical picture of hypertension and its management. He has devoted a considerable amount of labor in outlining the fundamental background of what is known regarding this subject. The short historical survey is an example in point which will be greatly appreciated by the critical student. The subject matter is presented in logical sequence — clear and concise — and makes use of a terminology comprehensible to medical practitioners. The book is broad in its scope and timely in its message.

The author should be particularly commended for the analytical labor devoted to the exposition of the treatment of this condition, especially to the emphasis of the existing relationship of the physiopathological basis of hypertension and its rational management. This explanation permits the introduction of certain special and general remedies of value in the management of hypertension which is readily comprehended by the general practitioner. The various factors in dietitic control are not only discussed in a general manner but detailed diets are also suggested. Under specific medicinal therapy an interesting table of the various drugs has been included which points out the speed of their effect in their legitimate value. A splendid bibliography is appended in alphabetical order which suggests further collateral reading for those students especially interested in a particular development of the subject. This book is a scholarly contribution to the subject of hypertension and is heartily recommended to the profession.

CRIPPLED CHILDREN. THEIR TREATMENT AND ORTHOPEDIC NURSING. By *Earl D. McBride,* B.S., M.D., F.A.C.S., Instructor in Orthopedic Surgery, University of Oklahoma School of Medicine, Attending Orthopedic Surgeon to St. Anthony Hospital; Associate Orthopedic Surgeon to Oklahoma City General and Wesley Hospitals; Visiting Surgeon to W .J. Bryan School for Crippled Children; Chief of Staff to Reconstruction Hospital, Oklahoma City, Oklahoma. Cloth, $3.50, 280 Pp., 159 illustrations. St. Louis. The C. V. Mosby Company. 1931.

This book emphasizes the importance for early recognition of orthopedic conditions. This viewpoint is unquestionably the correct one, for, too often, procrastination and delay have been responsible for poor results. As is set out in the foreword: "This book should have many friends among those who have the care and responsibility of crippled children, for they will find in it an aid in recognizing many of these orthopedic conditions in the early stages, when much can be accomplished by treatment, and a guide in the preventive care, which may be given to such patients."

Primarily, the author's purpose is to inform the nurse in her training and practice. The social worker and parent, too, should benefit by the text material. There is no doubt that orthopedic textbooks are too technical for the average individual without medical training. "Verbal instruction at its best is but fragmentary and open to misunderstanding." Those who are interested in the relief of deformities and physical handicaps — especially of children, should therefore find this little volume useful, not only for the information which it contains, also for a guide and inspiration in their noble endeavors.

The twenty-four chapters cover practically every phase of the subject. Technic for nurses in surgical orthopedics is detailed in an original manner. The postoperative nursing duties, likewise, are enumerated in a chapter devoted to this work. Physical therapy is discussed in Chapter IX. While rather brief, it is impressive and is probably one of the few attempts of an author to place on record the value of this branch of therapeutics in the orthopedic specialty.

Infantile paralysis is discussed at some length and rightfully so. It is one of the outstanding problems in orthopedics and merits much consideration in any treatise dealing with bone and joint conditions. The author injects a personal touch in this as well as other diseases discussed. His views are, however, supported by an extensive experience.

The illustrations are well made and represent a determined effort to portray more vividly a mental picture of the various diseases described. Both the author and the publisher should be commended for presenting a valuable contribution such as this in book form.

DIAGNOSTIC METHODS AND INTERPRETATIONS IN INTERNAL MEDICINE. By *Samuel A. Lowenberg,* M.D., F.A.C.P., Associate Professor of Medicine, Jefferson Medical College; Assistant Physician to the Jefferson Hospital; etc.; second edition. Pp. 1032, with 547 illustrations. Cloth. Philadelphia: F. A. Davis Company. 1931.

It is difficult to conceive that a book more comprehensive in scope and detail could be written on Diagnostic Methods and Interpretation in Internal Medicine than that which has been contributed by Lowenberg. Every virtue of literary and scholarly workmanship is to be found in these pages. It is concise in the statement of facts and clear in its description of the vast material incorporated in the text. The author has taken advantage of this new edition to clarify and round out his treatise as suggested by reviewers and critics of his earlier edition. He calls attention that, "Corrections were made of typographical errors that had previously escaped notice, certain ambiguous statements were clarified and various omissions were filled in. In addition, some new material was incorporated as, for example, the cardiac blood supply and innervation, massive pulmonary collapse, coronary thrombosis, hyper- and hypotension, sickle cell anemia, Von Jaksch anemia, agranulocytic angina, acute mononucleosis, and the diagnostic importance of certain findings in the cerebro-spinal fluid."

In order to keep the work within reasonable bounds, it is felt that the author has often sacrificed detail for brevity. This shortening is recognized by the author who calls attention to the fact that such details may be obtained by referring to available manuals or special texts on the subject. Between the two "evils" the author has chosen the lesser and to the profit of the book. Advance students will therefore find many gaps in need of better filling in, while the general practitioner will encounter an encyclopedic detail often as bewildering as satisfying. In general the book represents an outstanding achievement. In line of constructive criticism it is suggested that, in the light of the new physicochemical interpretations given to serologic material, the chapter on *Interpretation of Laboratory Findings* be so evaluated in future editions. For example, the present concept of the blood sedimentation test as discussed in the present work is based

on the most superficial concept of the electrical phenomena underlying its action. The co-relationship of colloid and electrical phenomena it is now sensed, is inextricably bound up in all of our blood chemical tests. Thus far interpretations have been of the crudest nature because we have omitted from these tests an appreciation of the interplay of the forces recognized by physical chemistry.

The volume, nevertheless, is an outstanding contribution. Progressive physicians cannot afford to be without its guidance. It should be the best thumbed volume in his library.

INTERNATIONAL ABSTRACTS

Diathermic and High Frequency Currents in Neisserian Infections. Benedict F. Boland.

Am. Jour. Phys. Ther. **8**:5 (April) 1931.

The scope of this investigation involves use of medical diathermy and the study of the bacteriology of each case to determine what effect followed the use of this treatment. Cases varied from the acute first type to the tubular involvement. The technic consisted in connecting one terminal of a diathermic current to a sacro-abdominal electrode and a special cervical electrode inserted into the cervical canal. "Treatment varied from 20 to 30 minutes and depended upon the patient's tolerance. Each patient was started with a low amperage and gradually increased after the first seven minutes until her tolerance reached a point when the thermometer reading read between 112° F. and 116° F. Profuse cervical discharge followed the cervical treatment. Cultures made after treatment produced a more abundant growth of the organism on the media and grew readily." The author summarizes his work in the following conclusions: "Diathermic heat to the cervix produces an active hyperemia, leucocytosis and relief of pain.

Cervical heat of 112 to 116° F. or 41 to 45° C. does not inhibit the growth of gonococcus either in vitro or culture.

Heat above 116° F. in the cervix produces coagulation.

Cutting current is effective in the removal of diseased cervical tissue.

Conization of the cervix with high frequency current can be carried on under local anesthesia.

Tissue for biopsy can be obtained by the same method."

Classification, Etiology and Therapy of Chronic Rheumatism. F. Gudzent.

Am. Jour. Phys. Therap. **8**:25 (April) 1931.

The author reviews the various classifications and some of the salient causative factors in chronic rheumatism. Attention is directed to the unsettled state of our knowledge regarding the rheumatic problem. His personal experience makes him view the focal infection theory with a degree of skepticism. There was a definite lack of uniformity in results following the correction and removal of focal points of infection. Hence chronic infection still remains a theory that is in need of further research.

The conflicting views on etiology and classification makes the therapeutics of this affection a difficult problem. The author here limits his discussion to the usefulness of x-ray and radium treatment. He feels that these neglected forms of treatment will give better results than any other method if properly applied. Providing the joints have not been irreparably damaged, considerable improvement can be observed in chronic arthritis and even in arthritis deformans. The *x-ray* dosage is as follows: Irradiating the joints alternately at weekly intervals, antero-posteriorly and posterio-anteriorly, with a surface dose of 7 Holzknecht units, in all about 15 to 16 Hu. An erythema is thus produced in 12 to 14 days. After six weeks a repetition of treatment may be instituted. Intensification of symptoms may follow which is followed by reduction in pain, inflammation and in increased mobility.

Radium treatment may be given in the form of placing 10 mg. of radium preparation around the affected joint, filtered through 15 mm. of brass at a distance of 1 cm. from skin, for 3-4 hours. Treatment may be repeated after a few weeks. "*Mild radium therapy* with radioactive substances is cheap and effective. We have to distinguish between gaseous matter — emanation — and soluble salts. Emanations may be given in the form of: (a) inhalations; (b) liquid solutions (water, oil); (c) through the skin by means of the bath or emanatorium. Soluble salts (radium bromide, radium chloride, thorium) are given by: (a) injection, (b) by the mouth. The injections must consist of absolutely pure radium chloride, radium-thorium or thorium-X. It may also be taken in tablet form, in solution by mouth or applied or spread over the part in the form of radium compresses which contain small quantities of radio-active matter spread over a comparatively large surface well mixed with some inactive matter and may be left on the affected part for many days without fear of causing burns. A preparation combining radium and atophan, "radiophan," has lately been produced. It may be injected intravenously or intramuscularly with beneficial results. Mild radium emanation, however, is not suitable in every case. We must exclude acute inflammatory forms as well as specific forms, i.e., lues, tuberculosis, gonorrhea, though even in these cases it may be of use in certain stages. The same applies to cases where widespread destruction and cicatrization of the synovia, cartillage and bone, although here also, some improvement may be effected. The action of radiation is a stimulator of biologic process, experiments show that mild radium therapy stimulates the hemato-

poietic organs, basic metabolism is augmented, uric acid secretion is stimulated, blood pressure is reduced, and the activity of the ductless glands (suprarenals) are increased. All the foregoing factors may explain the cure observed in chronic rheumatism.

Arthritis Deformans. Dr. Krebs, Director of the Landesbad, Aachen.

Fortschritte der Therapie. **9,** 1931.

The most energetic methods are usually devoted to the relief of pain, whereby the inflammation is combated at the same time. Gelonida antineuralgica (up to 5 to 6 tablets daily) have proved very valuable. If gastric disorders supervene, suppositories of Acetylin, Phenacetin ana 0.3 gm., Codein. phosphor. 0.02 gm. with or without the addition of 0.01 gm. extract. Belladonnae may be prescribed. A large number of tablets of a similar composition exists, for instance, »Treupel's Tablets«, and, in view of the chronic course of the disease, it seems advisable to change medicaments repeatedly. The writer has not seen much benefit from protein therapy; the same applies to Mirion which has been frquently recommended in recent times. In cases where physical therapy and treatment by baths cannot be used, protein therapy may be tried, but I should like to warn against using Sanarthrit on out-patients; it may produce unpleasant reactions and should therefore be reserved for treatment in institutions. — *Physical therapy* in its well-known forms is of the greatest importance in the treatment of arthritis deformans. Treatment by *hot liquid paraffin* is a valuable addition to that therapy; moreover, it is cheap and can be carried out in any household. In fairly large nursing homes the paraffin can be applied in the form of a spray in a pleasant and not inconvenient way by means of a spray apparatus. The firm »Helipharm«, Hanover, sells paper bags, made of specially prepared paper, of various shapes so as to fit the various peripheral joints, which any layman can pull over the joint in question and then fill with liquid paraffin. The writer very warmly recommends this paraffin therapy. It should furthermore be mentioned that under-water douches gain an ever increasing popularity. Especially the thermal douche and massage, as carried out with a highly developed technique in Aachen-Burtscheid, always have a favorable effect on the function and pain. — With regard to surgical treatment of arthritis deformans, a definite verdict cannot yet be pronounced especially in respect of permanent results. Injections of camphorated carbolic acid into the joints, which have been recommended by *Payr,* have been entirely abandoned by the writer after a number of distressing failures. Orthopedic treatment offers better prospects of success. The author would like to call attention to a supporting belt which he has found greatly serviceable with spondylitis deformans in the last three years. It consists of the material of which belts are made with a rubber lining, about 15 cm. in breadth; it is fastened in the front by four loops and has on the back a solid pad 8 to 10 cm. breadth. It should be so shaped that it fits quite tightly onto the lumbar portion of the vertebral column, which usually shows a deep lordotic concavity; affords the feeling of having a firm support to the patient (especially if he has a fat abdomen) and, apart from this, a feeling of warmth which most of the patients long for (and why they wear cats' skins, etc.). In contrast to the supports reaching as far up as the armpits, the belt hardly interferes with the patient's capability for work. *Gymnastics and medico-mechanics* should only be indulged in with great precaution in arthritis deformans. Efforts made to abolish the stiffening by such methods almost always fail but not infrequently damage has been done by forcible movements. Especially with injury of the vertebral column (and above all its lumbar portion) should any unnecessary movement of the back be avoided. In contrast to this, assiduous gymnastics of the back should be prescribed for Bechterew's disease (Spondylitis ankylopoetica). *Vigorous massage* of the muscles or soft parts of the back may be recommended for all the forms of spondylitis and spondylopathy. By strengthening the muscles which »erect« the back, the excessive burden weighing on the diseased bodies of the vertebrae and on the intervertebral discs is lessened. For this reason bandages involving a permanent immobilization should be avoided. — *Ars Medici,* October, 1931.

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* Continued from page 715.

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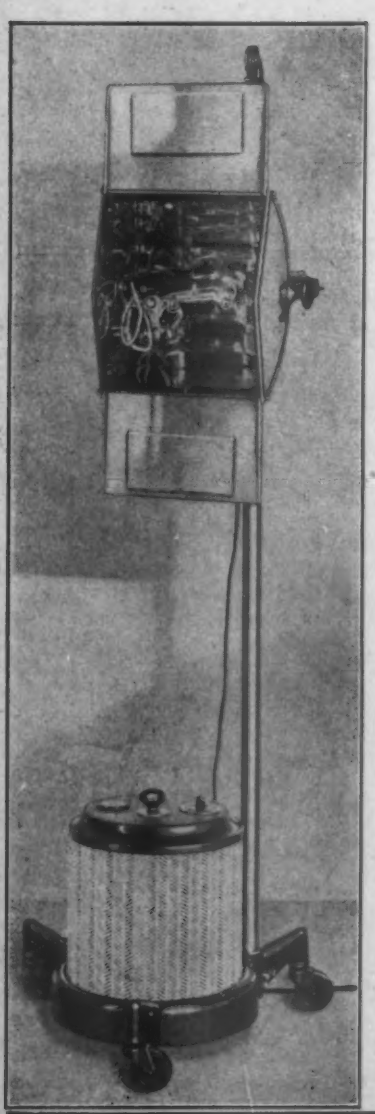

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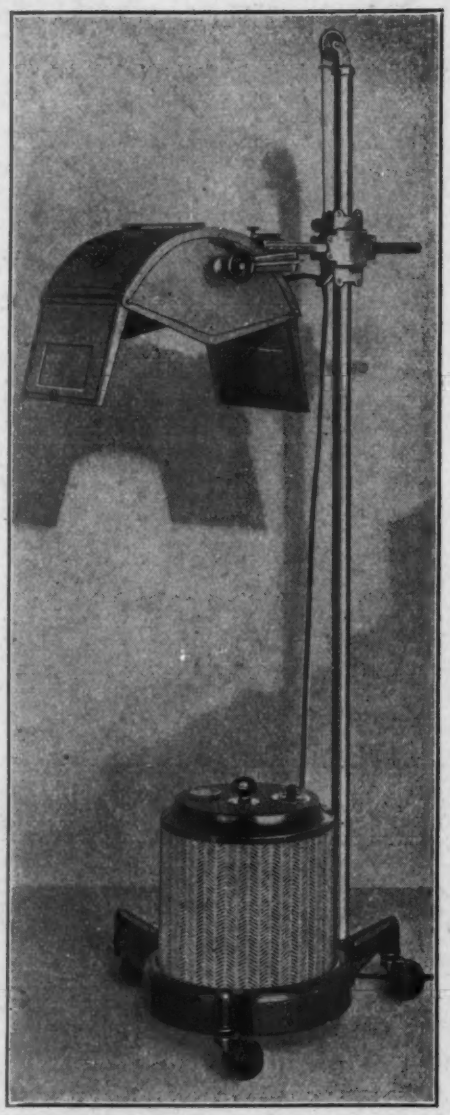

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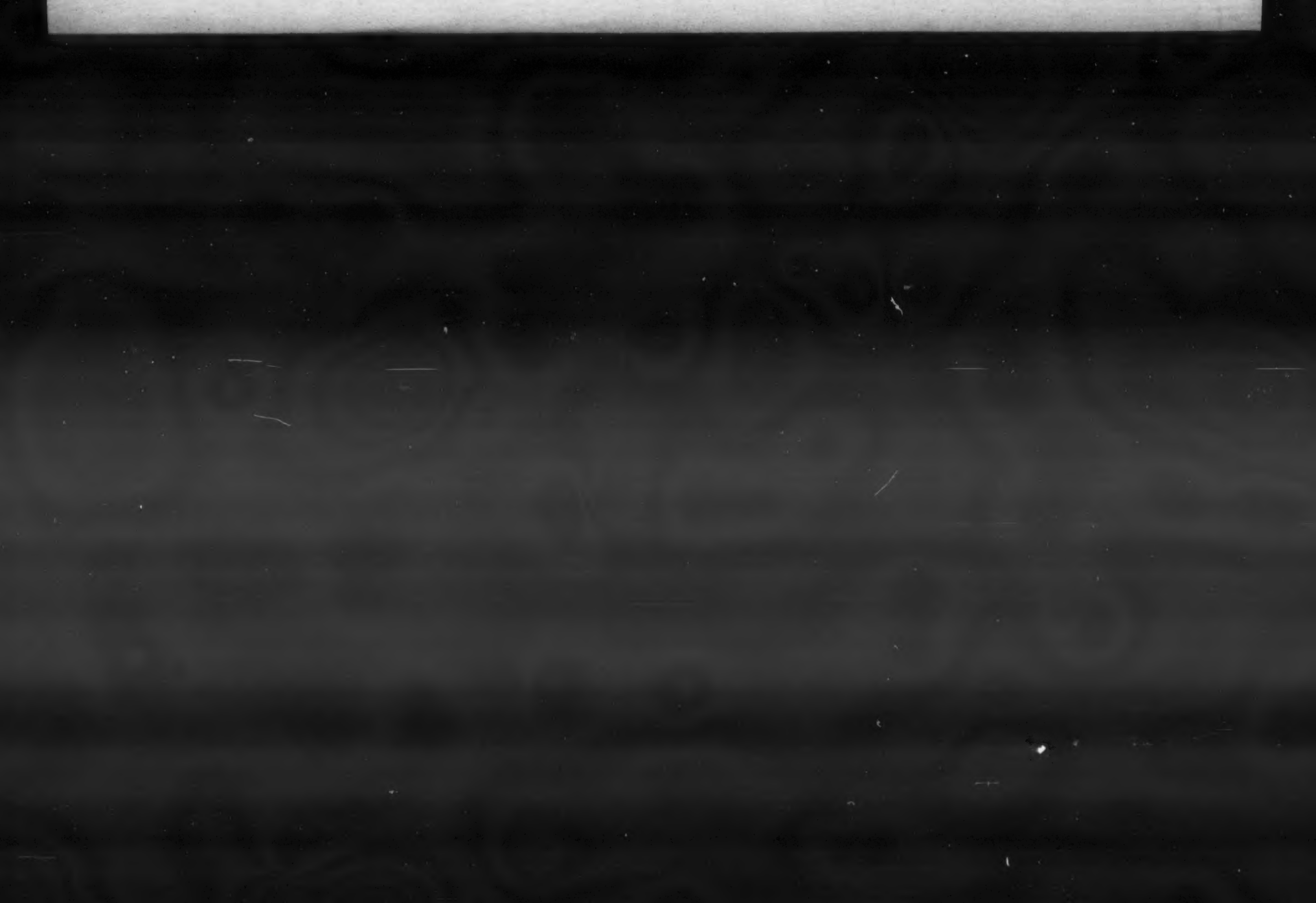

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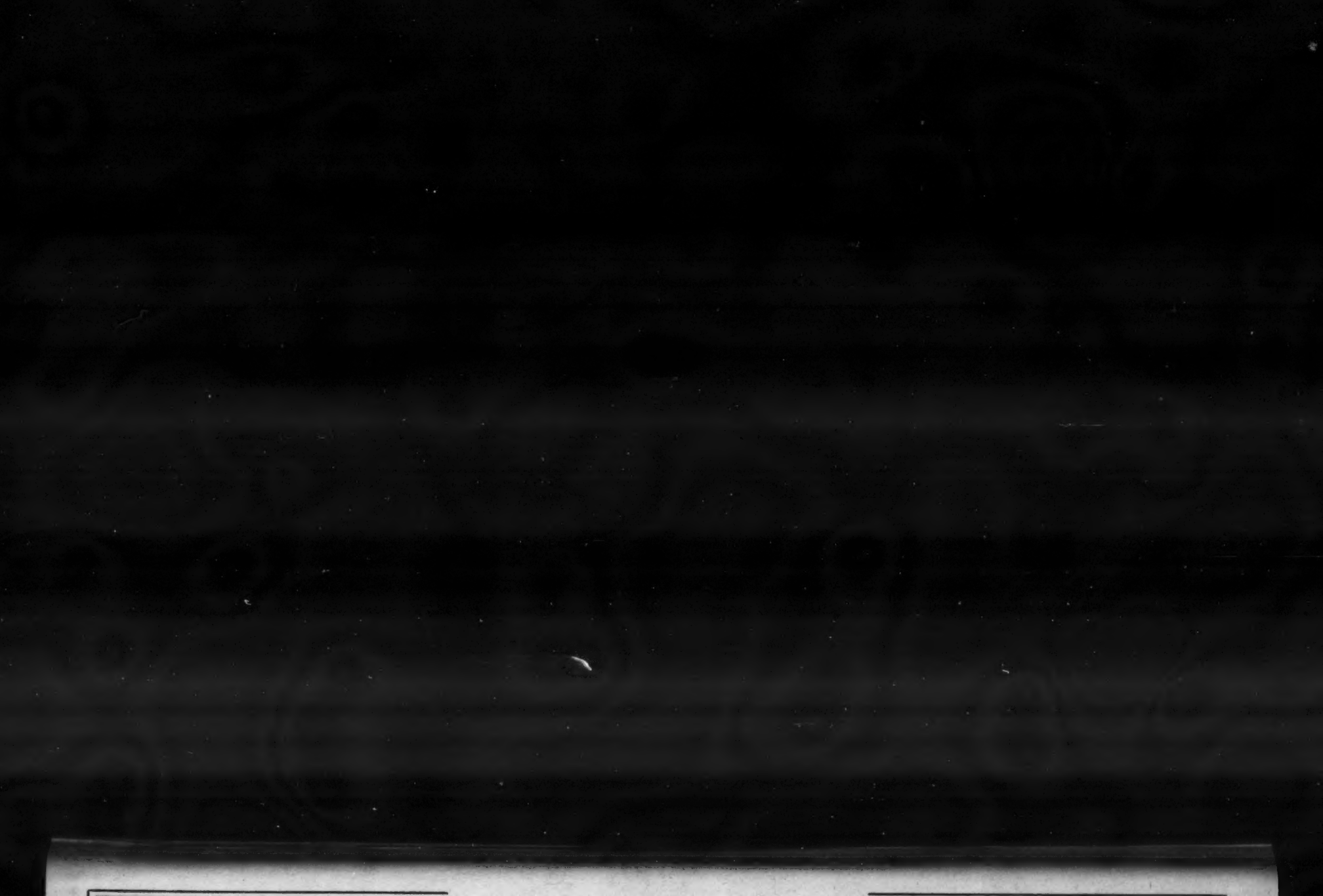

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